

Imaging TopoClustering on ScFi

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23/09/2025

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ElayerMode	sameLayerMode	diffLayerMode
xy	sameLayerDistXY	diffLayerDistXY
etaphi	sameLayerDistEtaPhi	diffLayerDistEtaPhi
tz	sameLayerDistTZ	diffLayerDistTZ
xyz	sameLayerDistXYZ	diffLayerDistXYZ

```
case ImagingTopoClusterConfig::ELayerMode::xyz:  
  return (std::abs(h1.getLocal().x - h2.getLocal().x) <= sameLayerDistXYZ[0]) &&  
    (std::abs(h1.getLocal().y - h2.getLocal().y) <= sameLayerDistXYZ[1]) &&  
    (std::abs(h1.getLocal().z - h2.getLocal().z) <= sameLayerDistXYZ[2]);
```

```
// ===== TopoClustering on ScFi =====
app->Add(new JOMniFactoryGeneratorT<ImagingTopoCluster_factory>(
    "EcalBarrelScFiProtoClusters_Topo", {"EcalBarrelScFiRecHits"},
    {"EcalBarrelScFiProtoClusters_Topo"},
    {
        .neighbourLayersRange = 2, // # id diff for adjacent layer
        .sameLayerDistXYZ      = {30.0 * dd4hep::mm, 30.0 * dd4hep::mm, 120.0 * dd4hep::mm},
        .diffLayerDistEtaPhi   = {10 * dd4hep::mrad, 10 * dd4hep::mrad},
        .sameLayerMode         = eicrecon::ImagingTopoClusterConfig::ELayerMode::xyz,
        .diffLayerMode         = eicrecon::ImagingTopoClusterConfig::ELayerMode::etaphi,
        .sectorDist            = 3.0 * dd4hep::cm,
        .minClusterHitEdep     = 0,
        .minClusterCenterEdep  = 0,
        .minClusterEdep        = 100 * dd4hep::MeV,
        .minClusterNhits       = 10,
    },
    app // TODO: Remove me once fixed
));
```

ScFi Topo Clustering : Two Photon Simulation

- Energy of Photon : uniformly random energy between 0 and 20 GeV
- Different emission angle θ (unit degree) :

Within Detector Acceptance : Choose a central angle within the detector's accepted range.
Position two particles symmetrically around this point so that they are separated by the required θ_{diff} , while keeping both within the detector's limits.

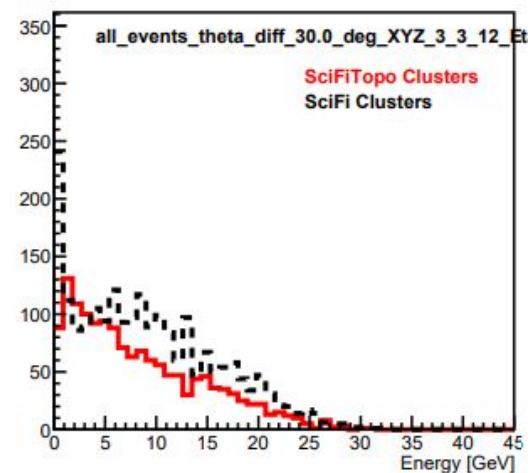
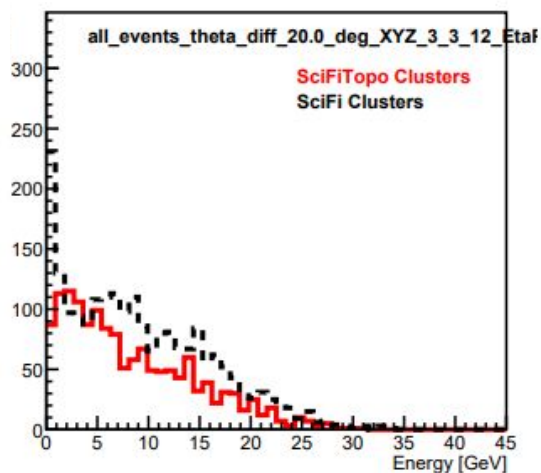
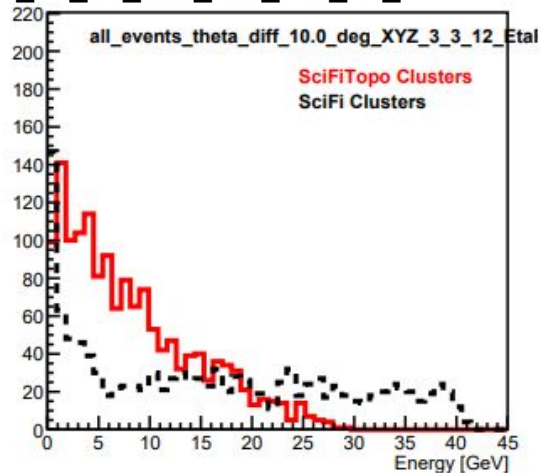
Island Clustering

```
app->Add(new JOMniFactoryGeneratorT<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  
));
```

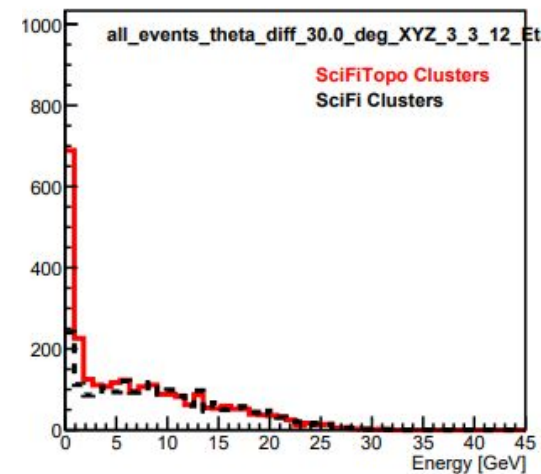
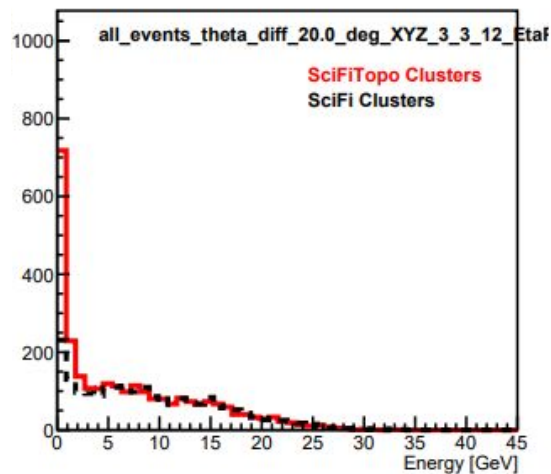
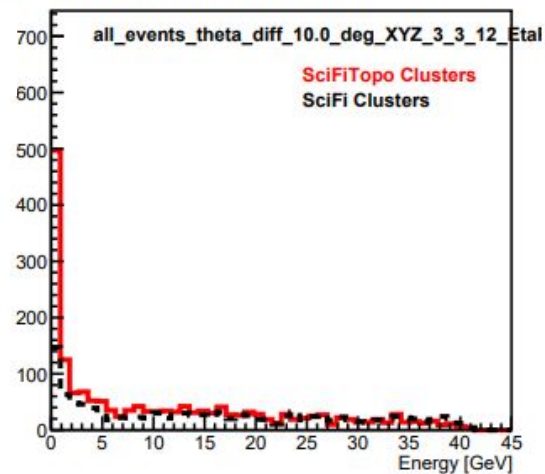
Imaging Topo Clustering

```
app->Add(new JOMniFactoryGeneratorT<ImagingTopoCluster_factory>(  
    "EcalBarrelScFiProtoClusters_Topo", {"EcalBarrelScFiRecHits"},  
    {"EcalBarrelScFiProtoClusters_Topo"},  
    {  
        .neighbourLayersRange = 2, // # id diff for adjacent layer  
        .sameLayerDistXYZ      = {30.0 * dd4hep::mm, 30.0 * dd4hep::mm, 120.0 * dd4hep::mm},  
        .diffLayerDistEtaPhi   = {10 * dd4hep::mrad, 10 * dd4hep::mrad},  
        .sameLayerMode         = eicrecon::ImagingTopoClusterConfig::ELayerMode::xyz,  
        .diffLayerMode         = eicrecon::ImagingTopoClusterConfig::ELayerMode::etaphi,  
        .sectorDist            = 3.0 * dd4hep::cm,  
        .minClusterHitEdep     = 0,  
        .minClusterCenterEdep  = 0,  
        .minClusterEdep        = 100 * dd4hep::MeV,  
        .minClusterNhits       = 10,  
    },  
    app // TODO: Remove me once fixed  
));
```

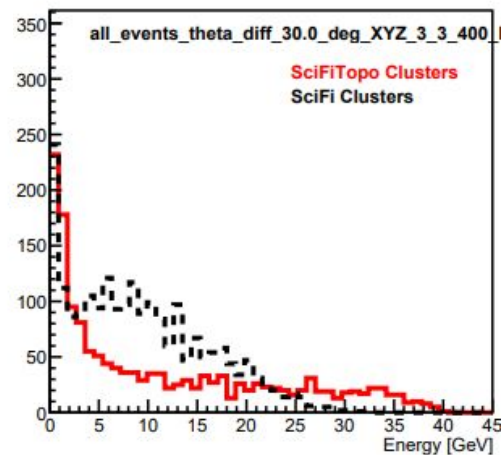
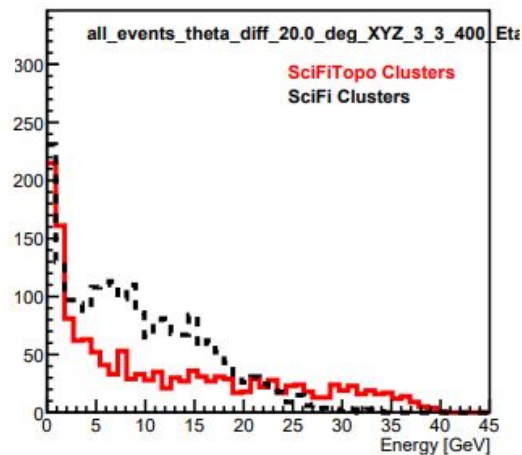
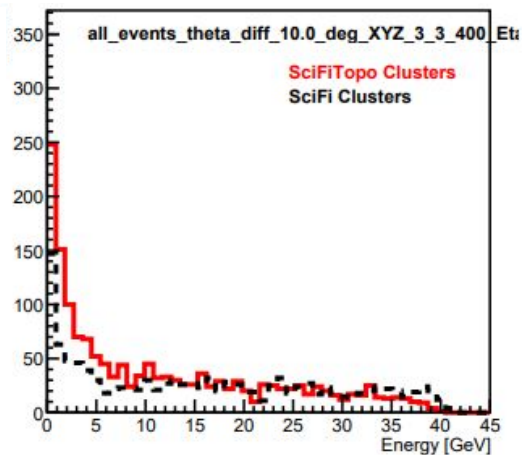
XYZ_30_30_120_Eta_Phi_10_10



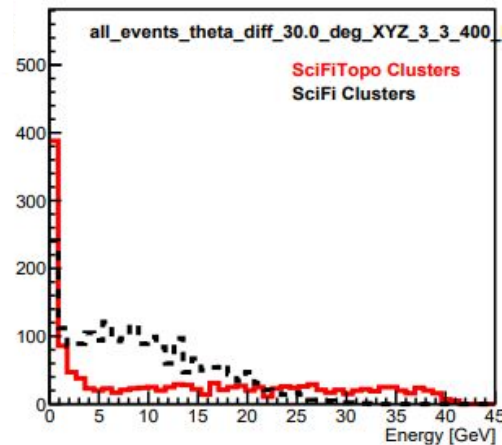
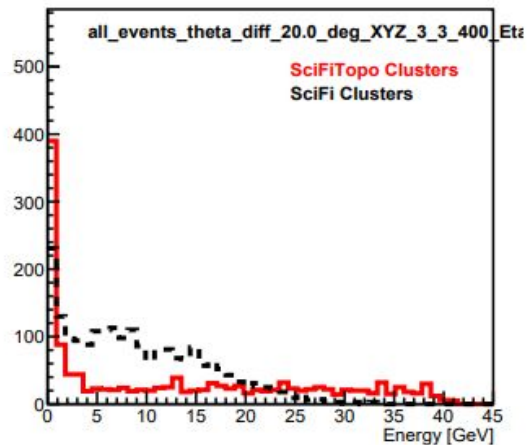
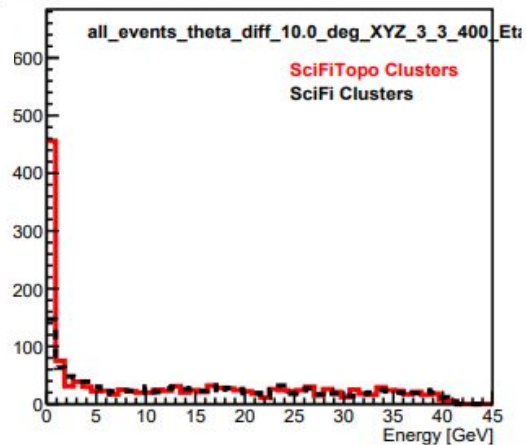
XYZ_30_30_120_Eta_Phi_80_80



XYZ_30_30_400_Eta_Phi_10_10



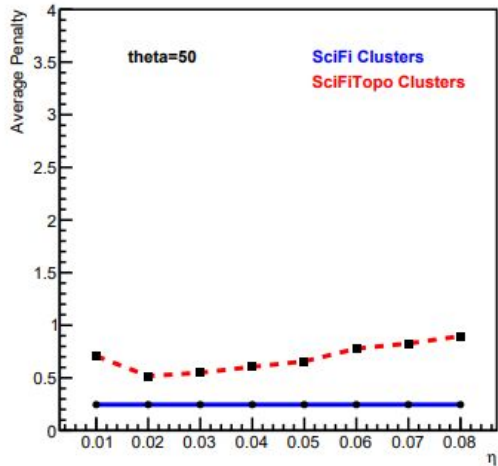
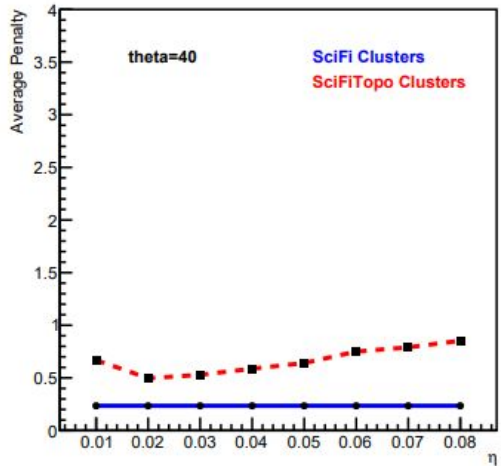
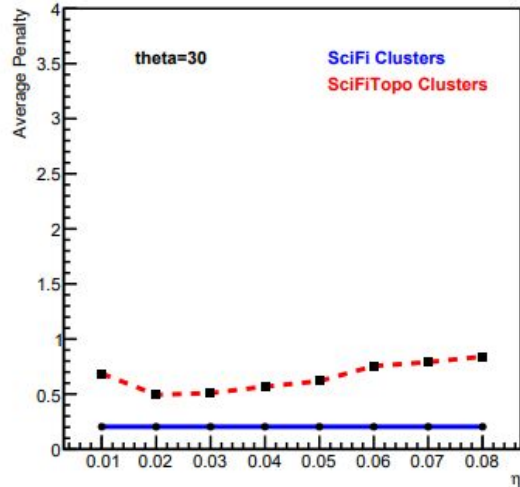
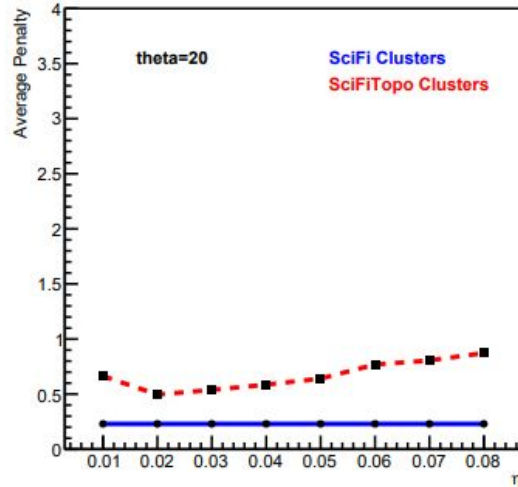
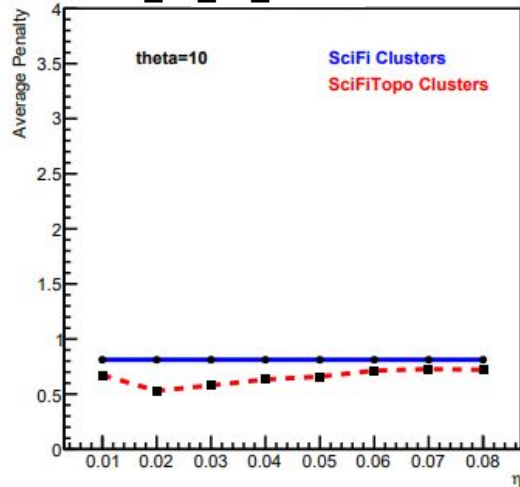
XYZ_30_30_400_Eta_Phi_80_80



Penalty:

Penalty Count = $\text{abs}(\text{cluster.size} - 2)$ for an event

XYZ_30_30_120

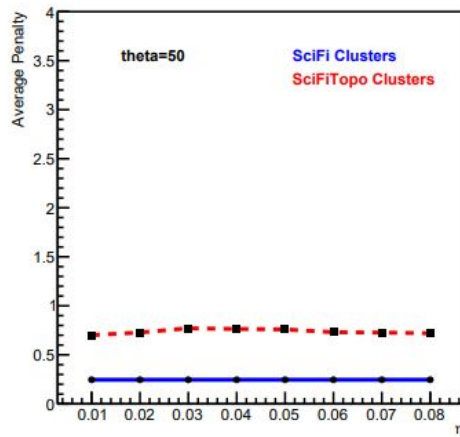
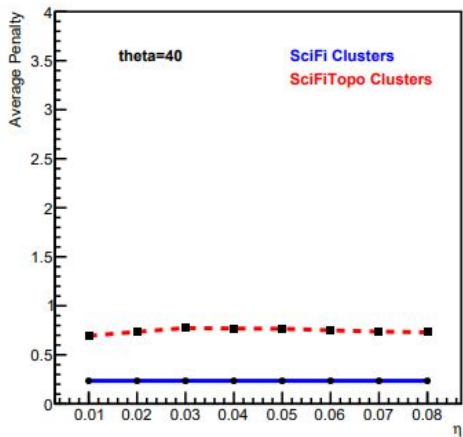
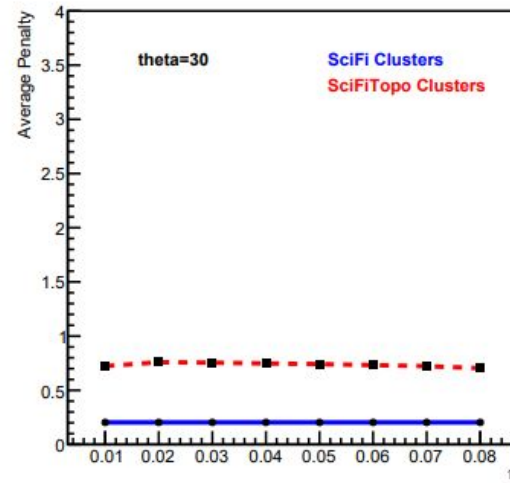
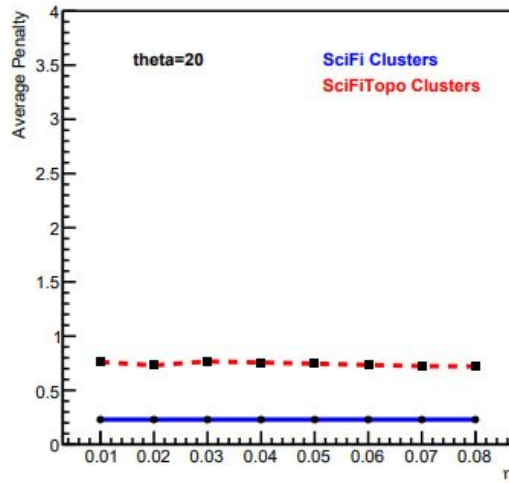
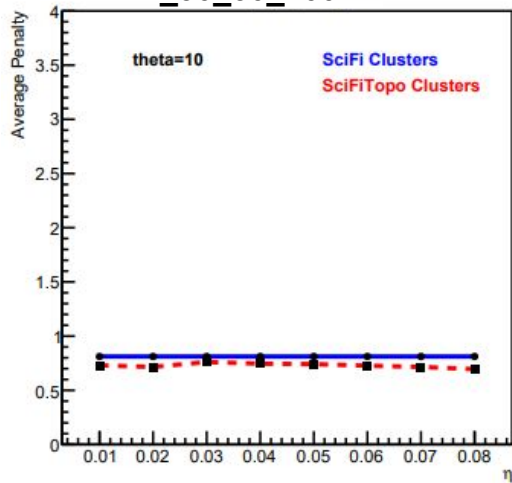


Here x axis is the different layermode etaphi values from 0.01 to 0.08. Same Layermode is XYZ at 30mm,30mm,120mm.

The trend of the ScFiTopo is consistent over different angular separation of the photons.

But the Penalty score is higher at large angular separation where the Island Clusters has a low penalty score.

XYZ_30_30_400

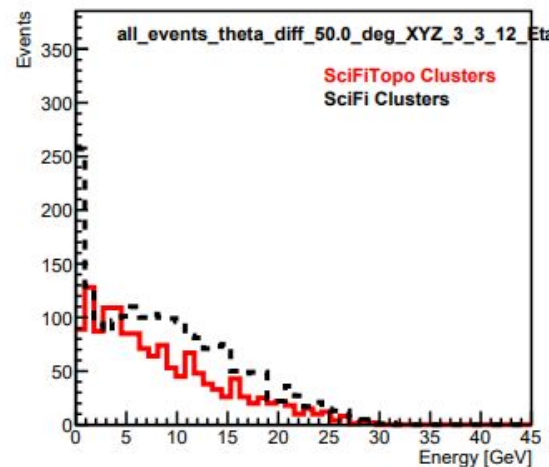
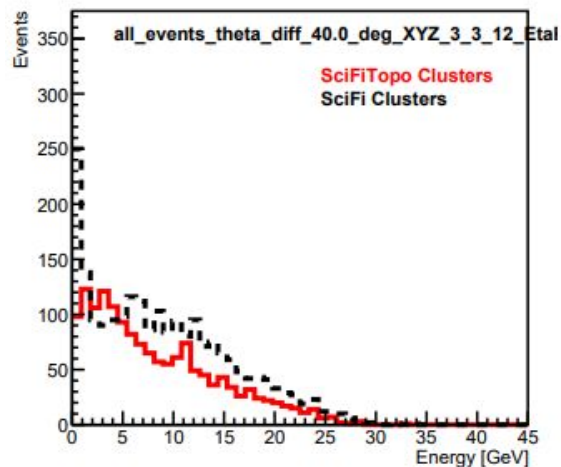
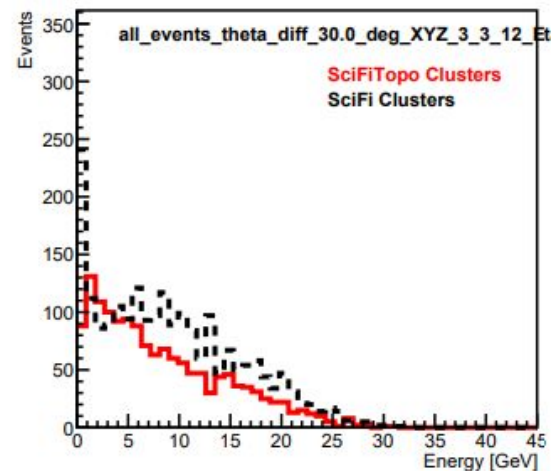
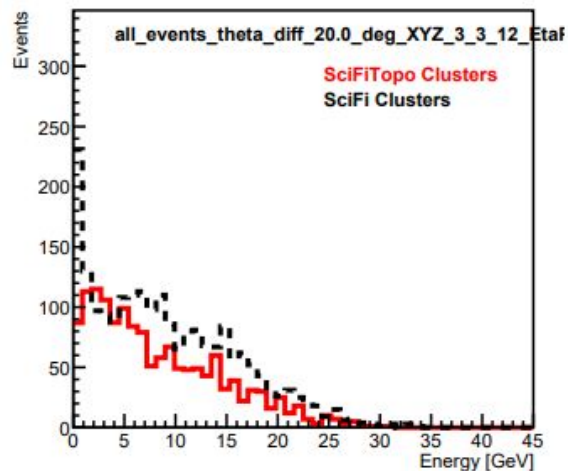
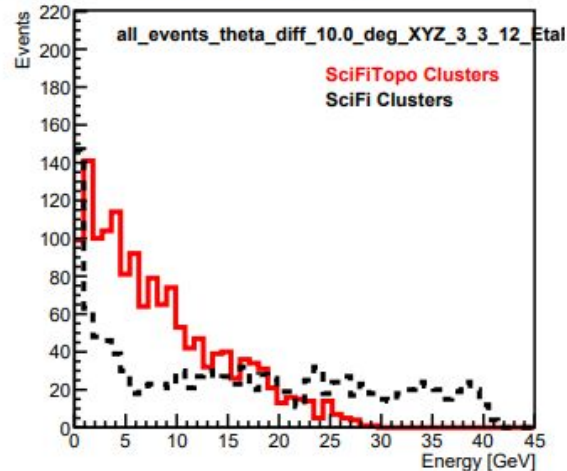


Here x axis is the different layermodes
etaphi values from 0.01 to 0.08. Same
Layermode is XYZ at 30mm,30mm,120mm.

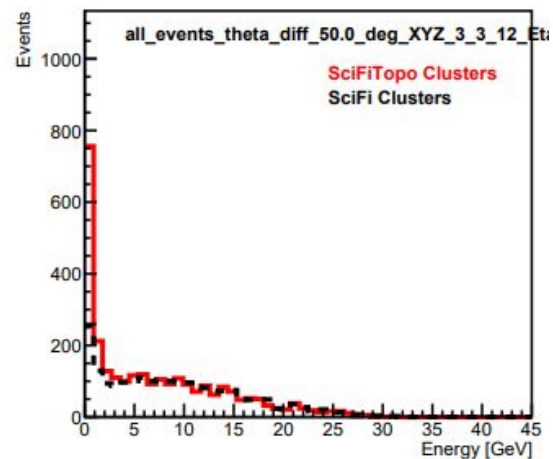
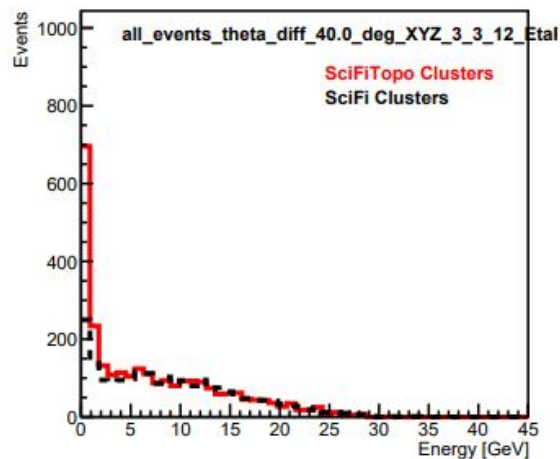
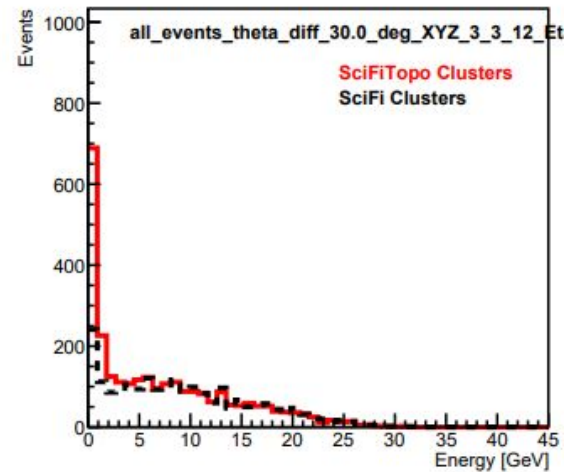
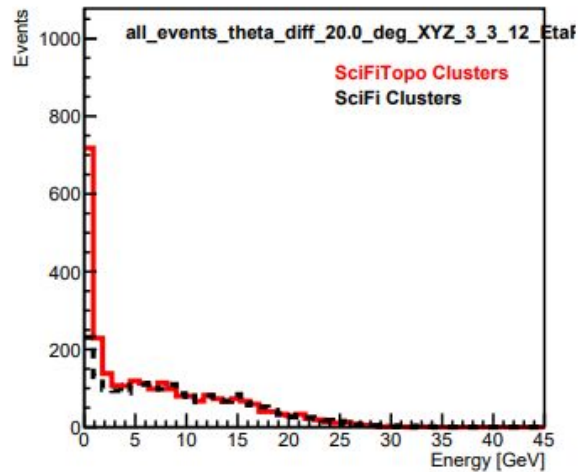
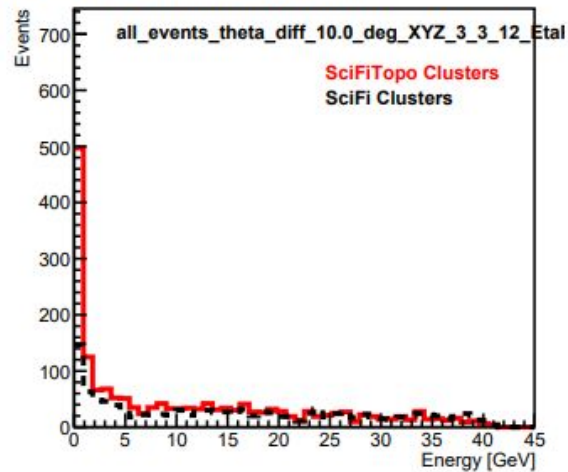
Next steps :

- Compare the hit contribution the ScFi Clusters and ScFi Top Clusters and then try to understand why does the Island cluster has a low penalty score at large theta.
- Penalty plots for $\text{theta-diff} < 10$

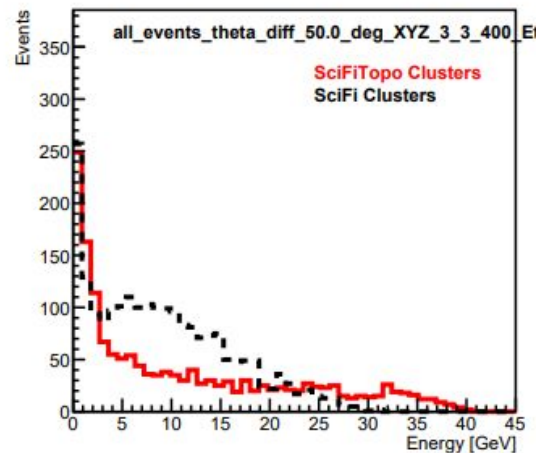
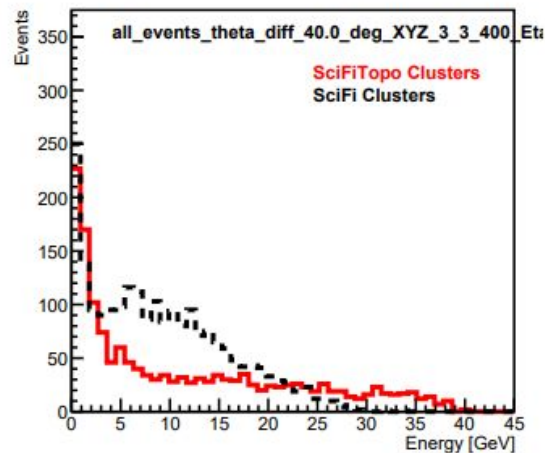
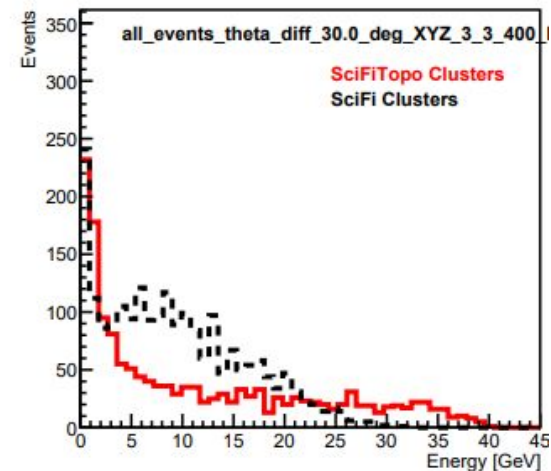
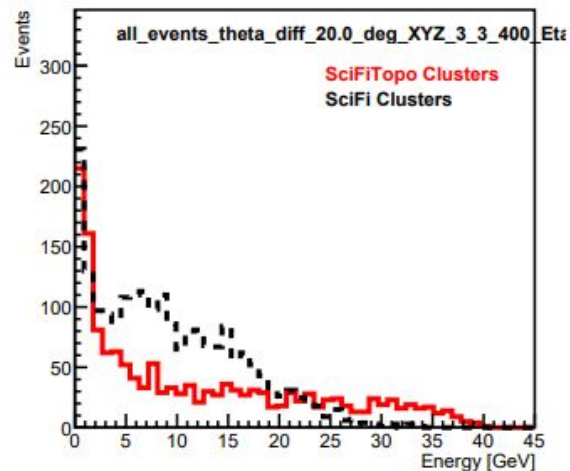
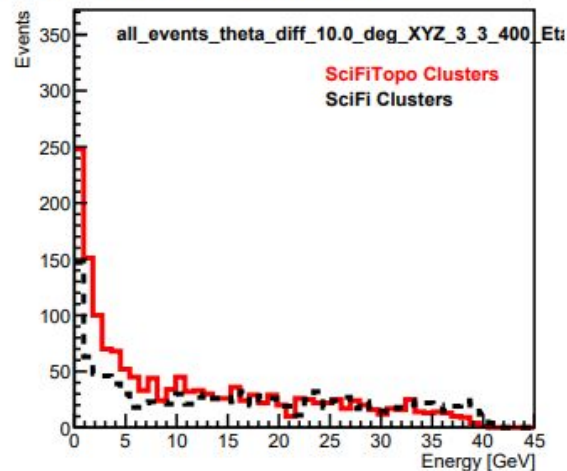
XYZ_3_3_12_EtaPhi_0.01_0.01



XYZ_3_3_12_EtaPhi_0.08_0.08



XYZ_3_3_400_EtaPhi_0.01_0.01



XYZ_3_3_400_EtaPhi_0.08_0.08

