photon Raa study

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Yeonju Go

Efficiency

Sample and Selection

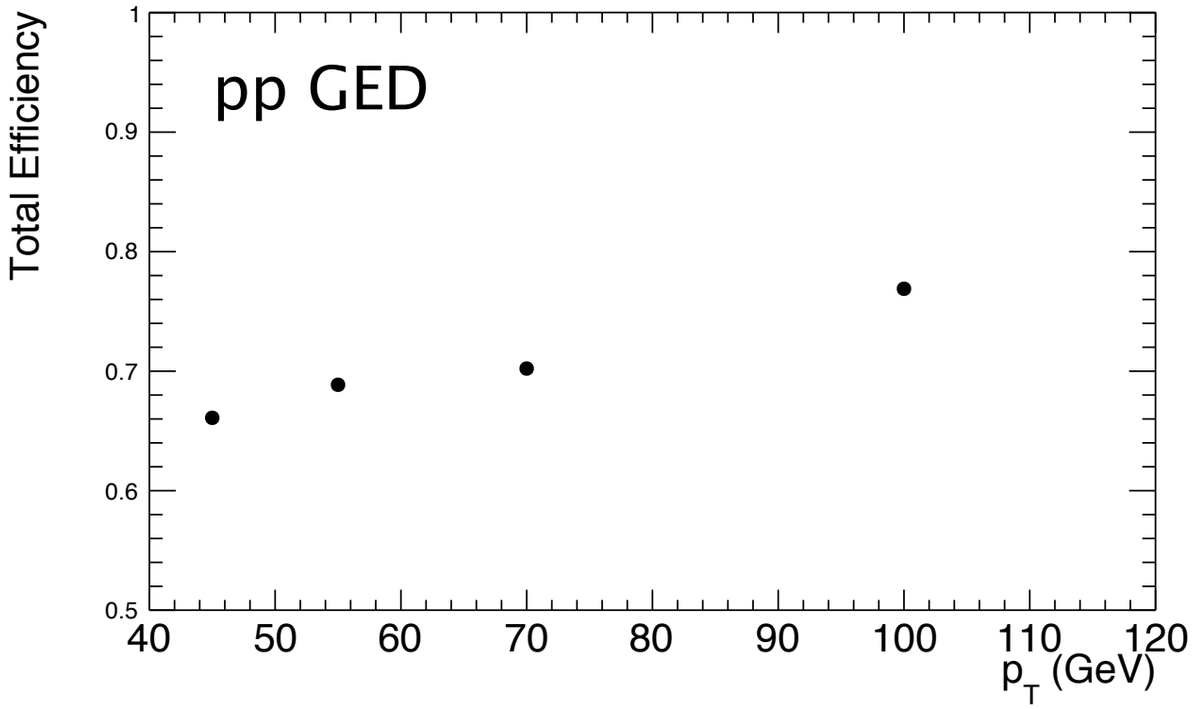
- **Samples : Official MC for pp and PbPb**
  - 15,30,50,80,120 pthat samples are merged and pthatWeight factors are applied
  - pthatWeight factors are posted on forest twiki
    : https://twiki.cern.ch/twiki/bin/view/CMS/HiForest2015#gamma_jet_samples
    : https://twiki.cern.ch/twiki/bin/view/CMS/HiForest2015#Photon_samples

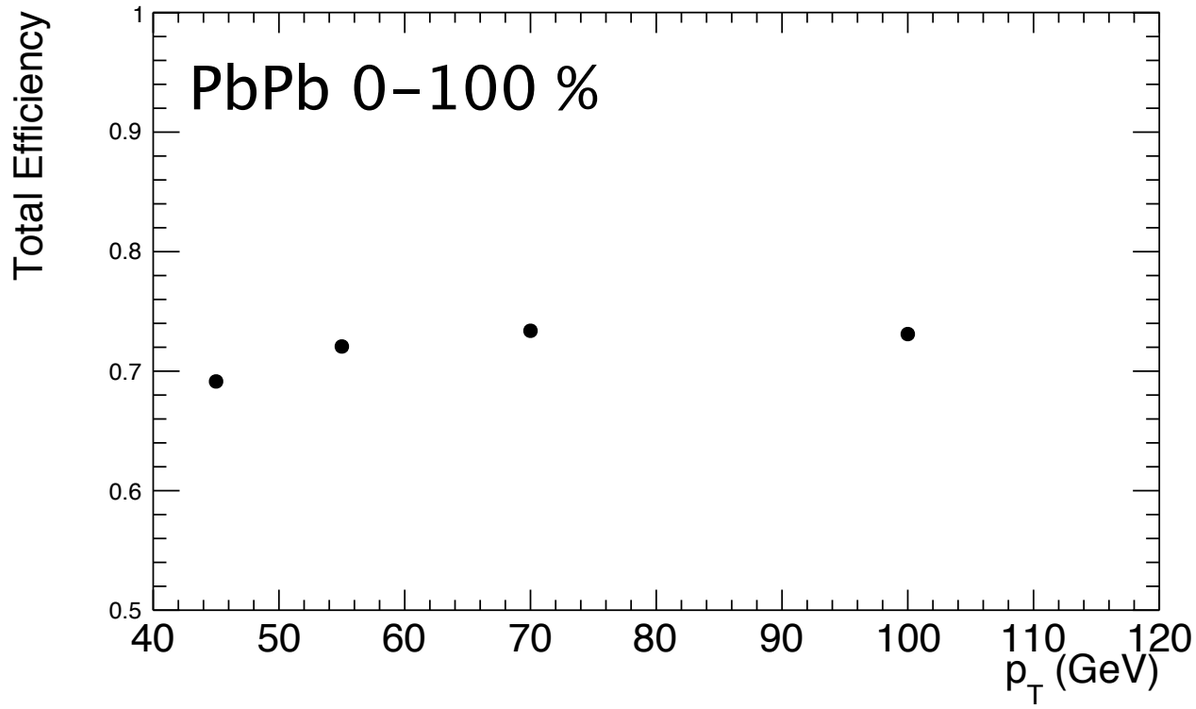
- **Reconstruction efficiency**
  - numerator = genMatched && (pid=22 && genIso<5)
  - denominator = (pid=22 && genIso<5)
  - dependence on momID was studied

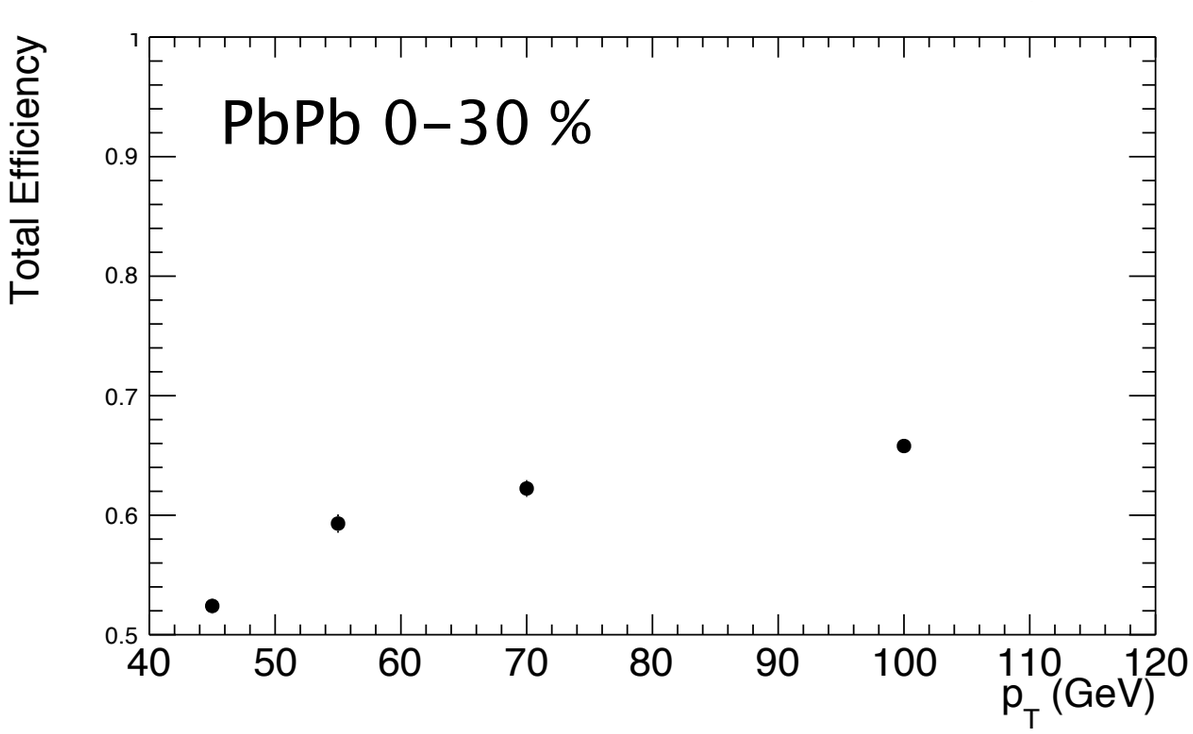
- **Total efficiency**
  - spike & hotspot rejected (hotspot cut by shower shape variables ex. e3x3, e1x5…)
  - numerator(pp) = (pfcIso<1.37) && (pfnIso<(1.06 + 0.014*pt + 0.000019*(pt)^2)) && (pfpIso<0.28 + 0.0053*pt) && (H/E<0.05) && (sigmaIEtaIEta<0.0102) && (genMatched && pid=22 && genIso<5)
    <- Medium cut for 25ns from EgammaPOG
  - numerator(pbpb) = (sumIso<1) && (H/E<0.1) && (sigmaIEtaIEta<0.01) && (genMatched && pid=22 && genIso<5)
  - denominator = (pid=22 && genIso<5)

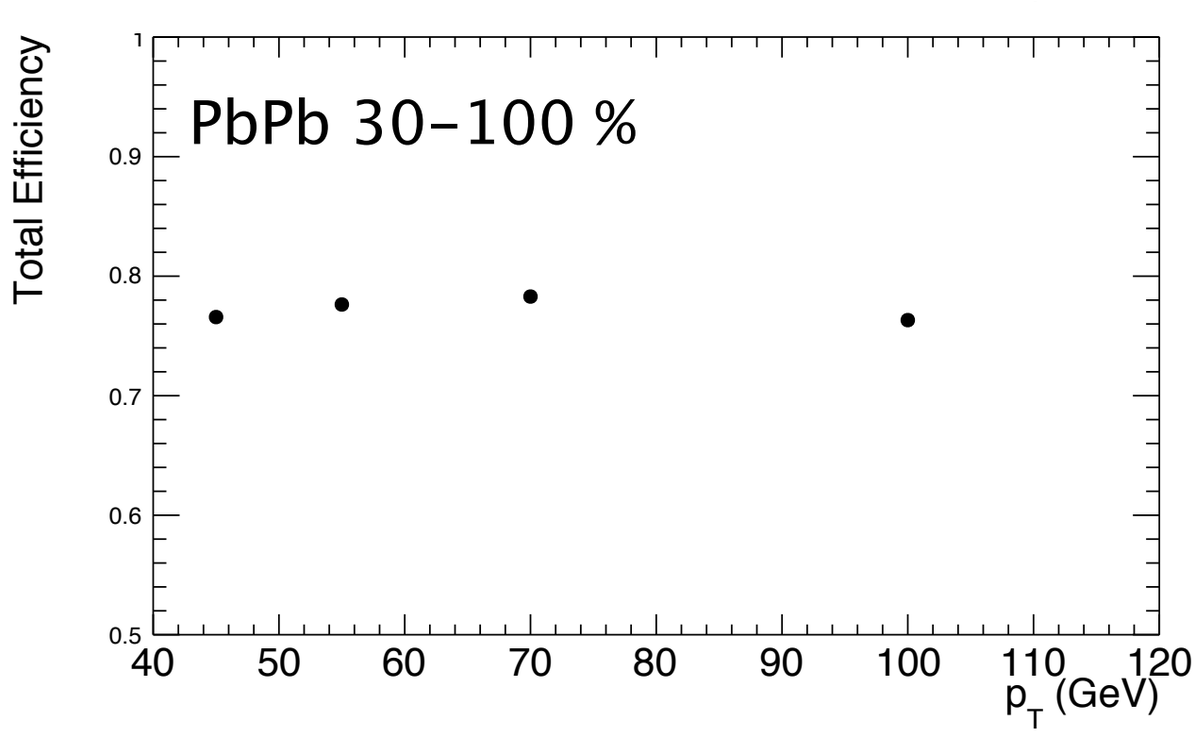
- **Gen matching condition**
  - the closest pT between gen and reco in deltaR < 0.15.
- **|eta| < 1.44 is applied**

Total Efficiency





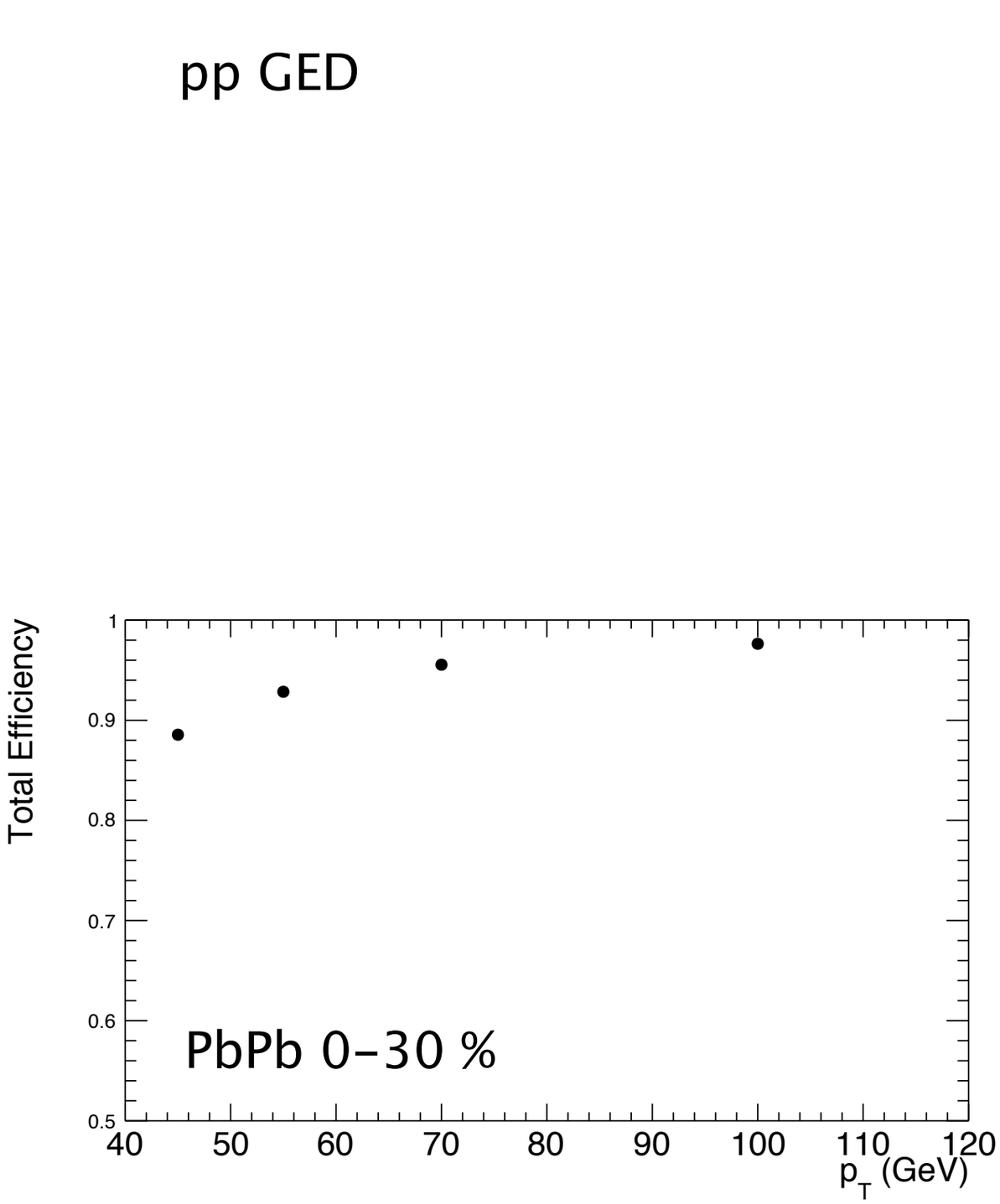


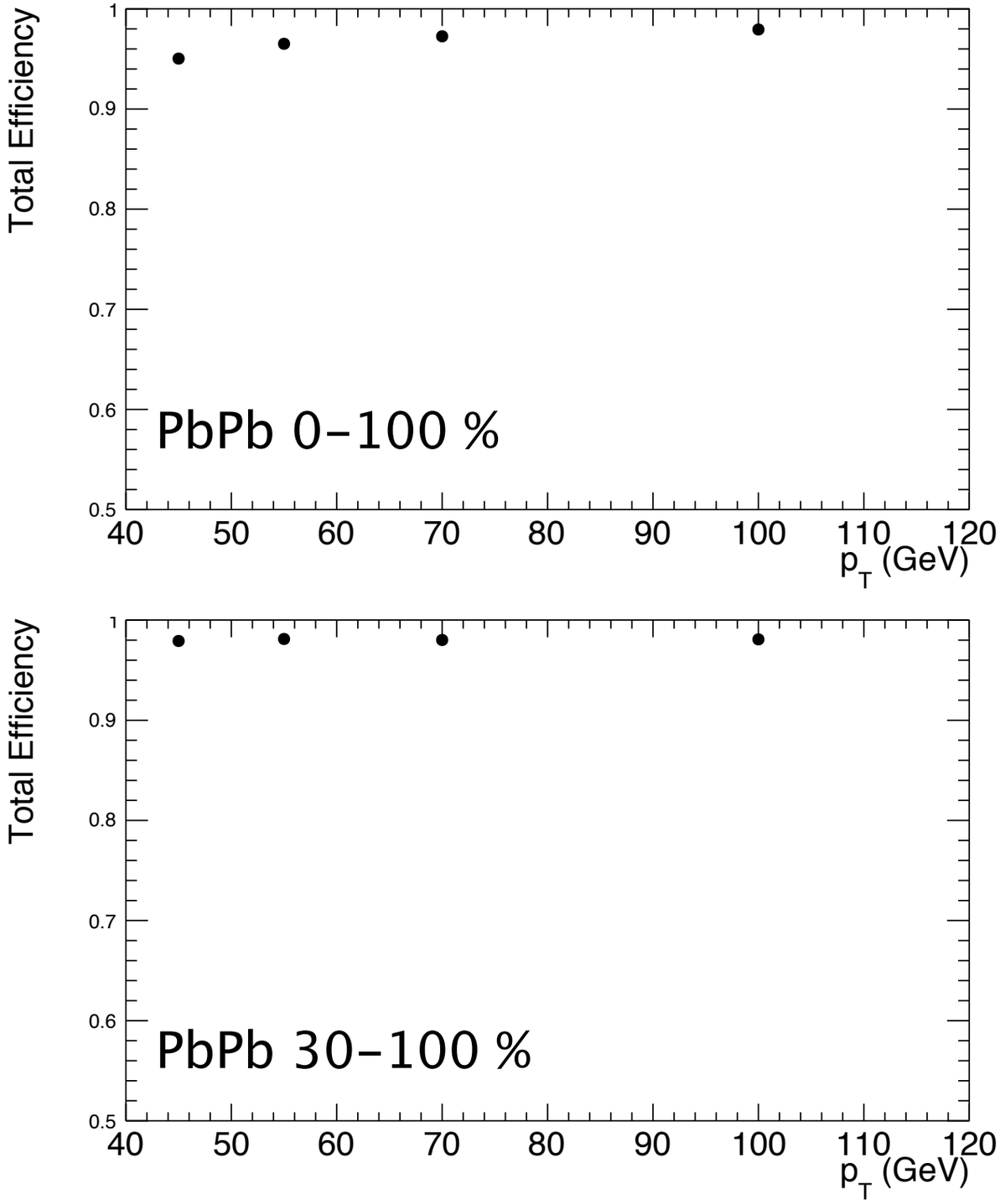


- numerator(pbpb) = (sumIso<1) && (H/E<0.1) && (sigmaIEtaIEta<0.01) && (genMatched && pid=22 && genIso<5)
- denominator = (pid=22 && genIso<5)

HoverE Efficiency

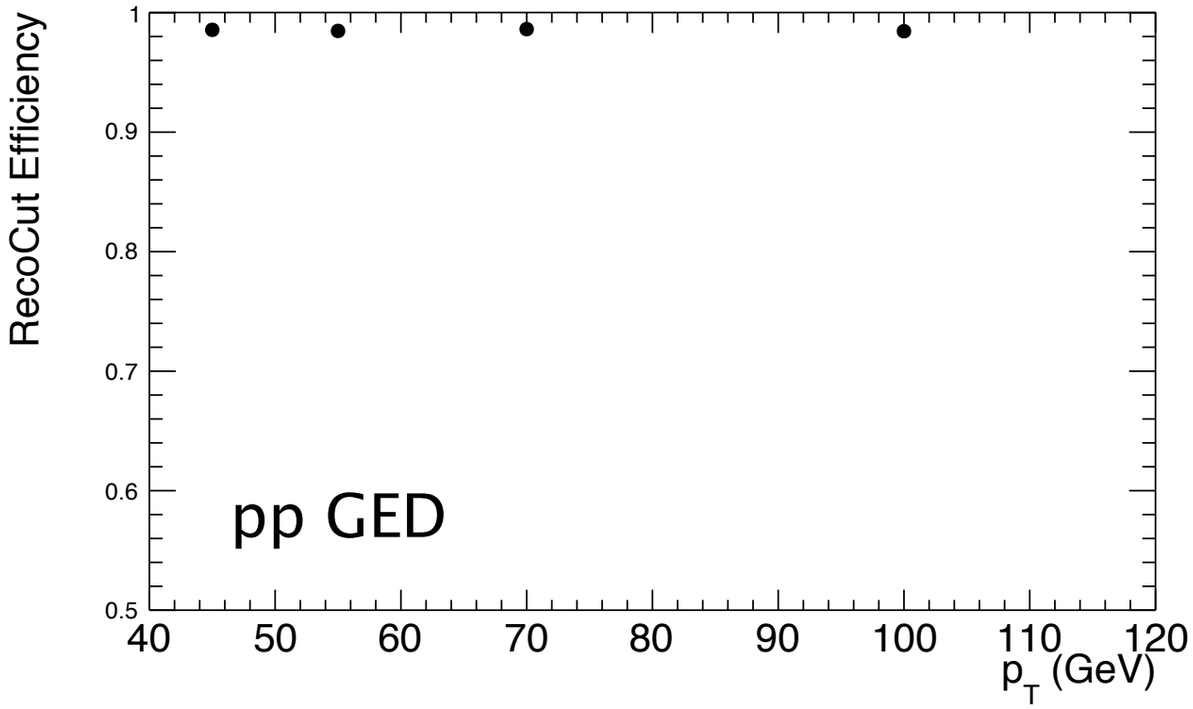
pp GED

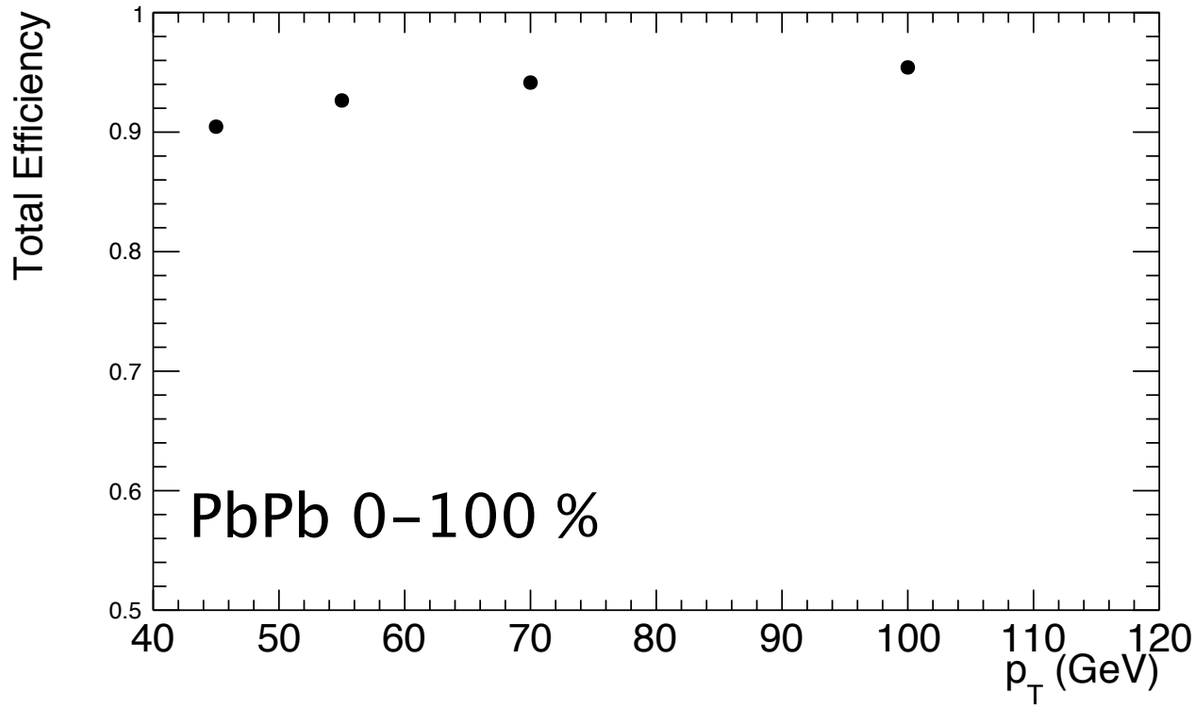


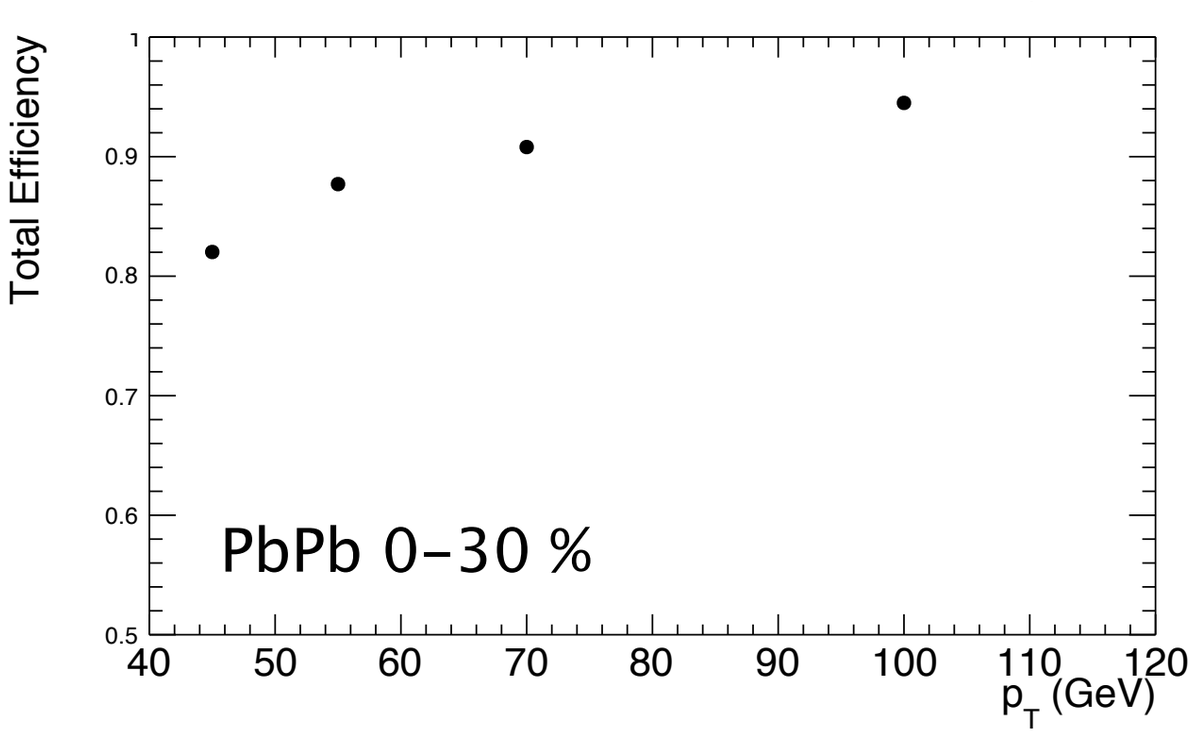


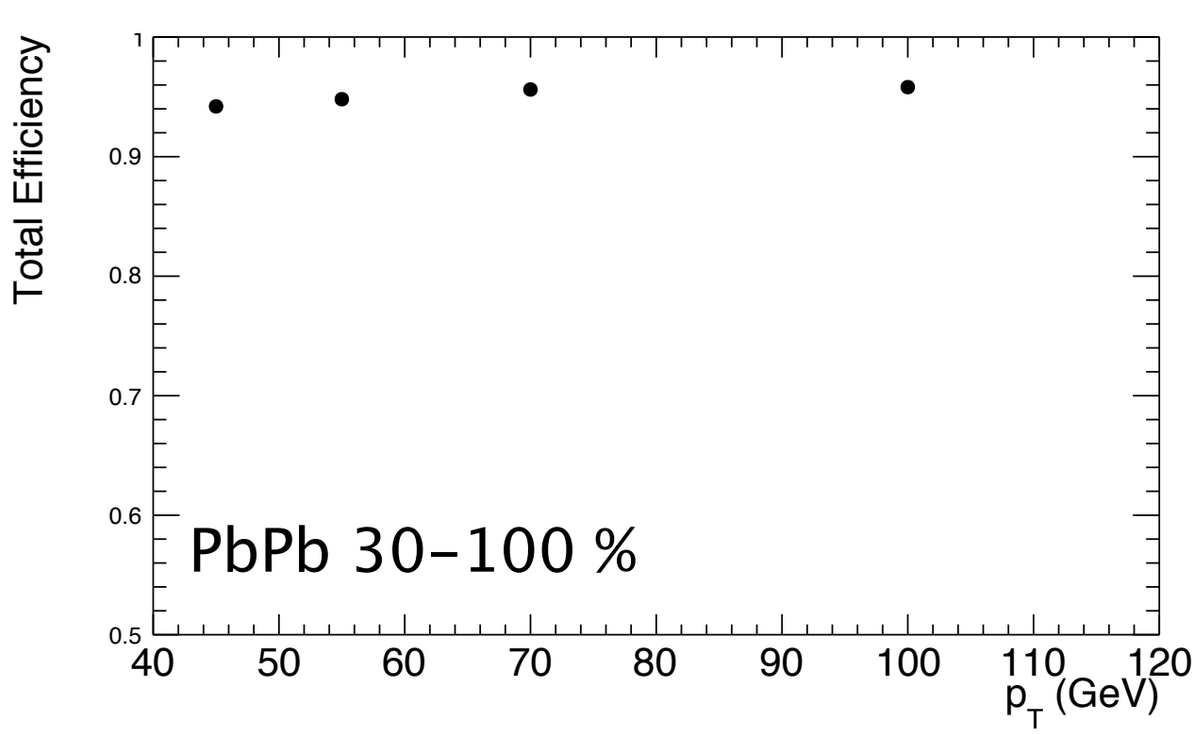
- numerator(pp) = (h/e<0.05) && (genMatched && pid=22 && genIso<5)
- numerator(pbpb) = (h/e<0.1) && (genMatched && pid=22 && genIso<5)
- denominator = (pid=22 && genIso<5)

SigmaIEtaIEta Efficiency



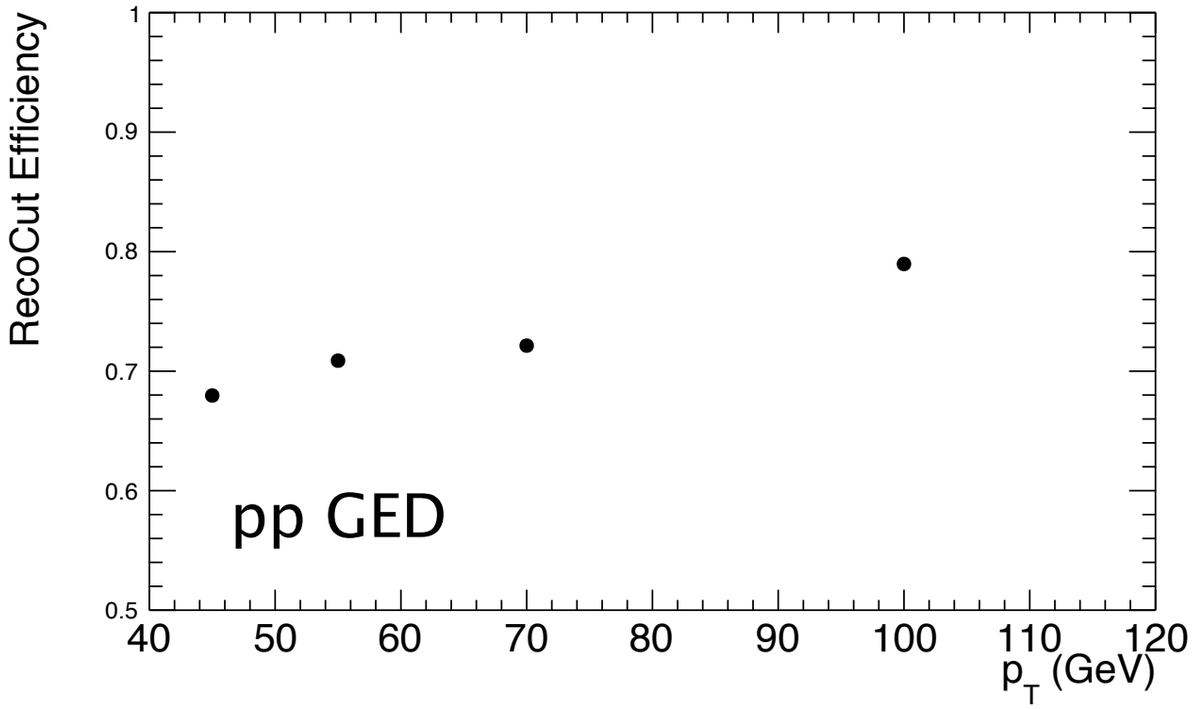


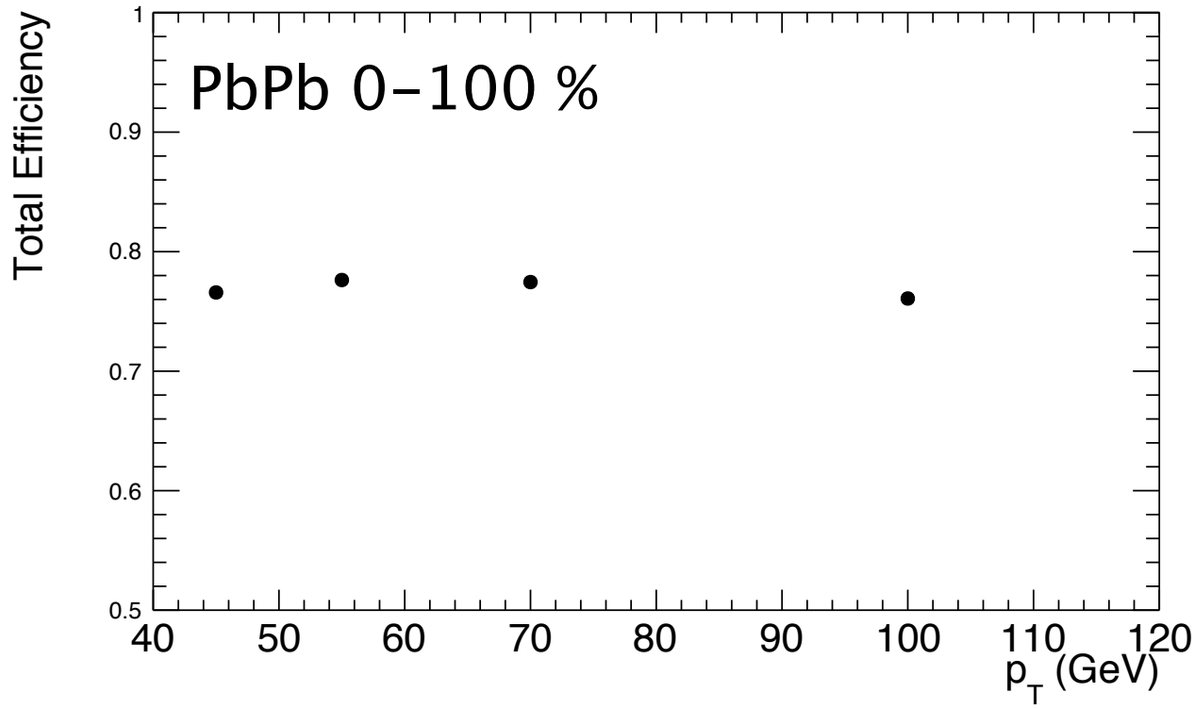


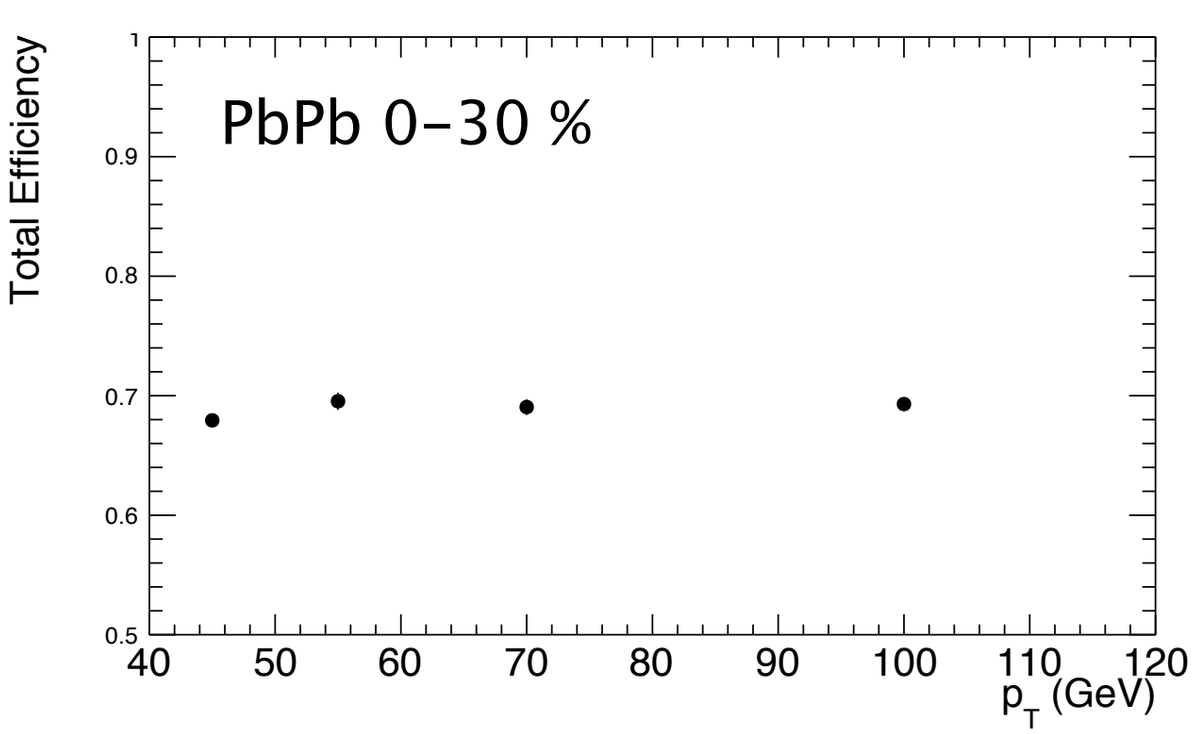


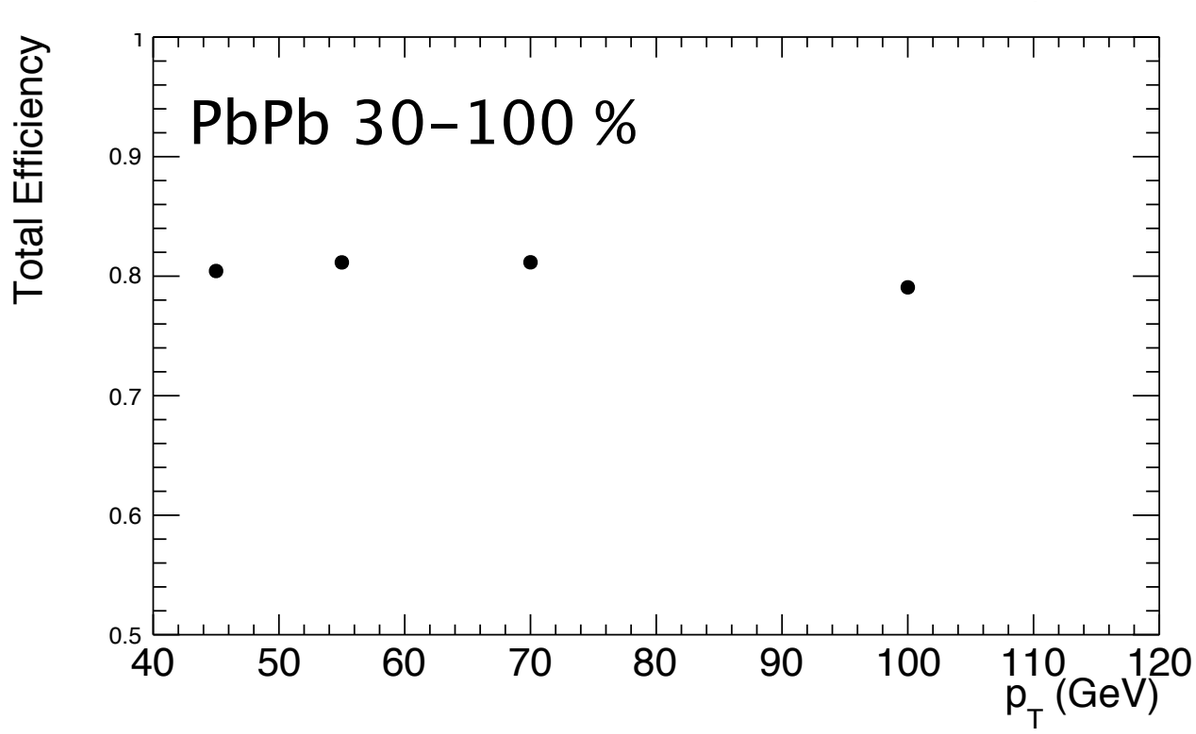
- numerator(pp) = (sigmaIEtaIEta_2012<0.0102) && (genMatched && pid=22 && genIso<5)
- numerator(pbpb) = (sigmaIEtaIEta_2012<0.01) && (genMatched && pid=22 && genIso<5)
- denominator = (pid=22 && genIso<5)

SumIso Efficiency





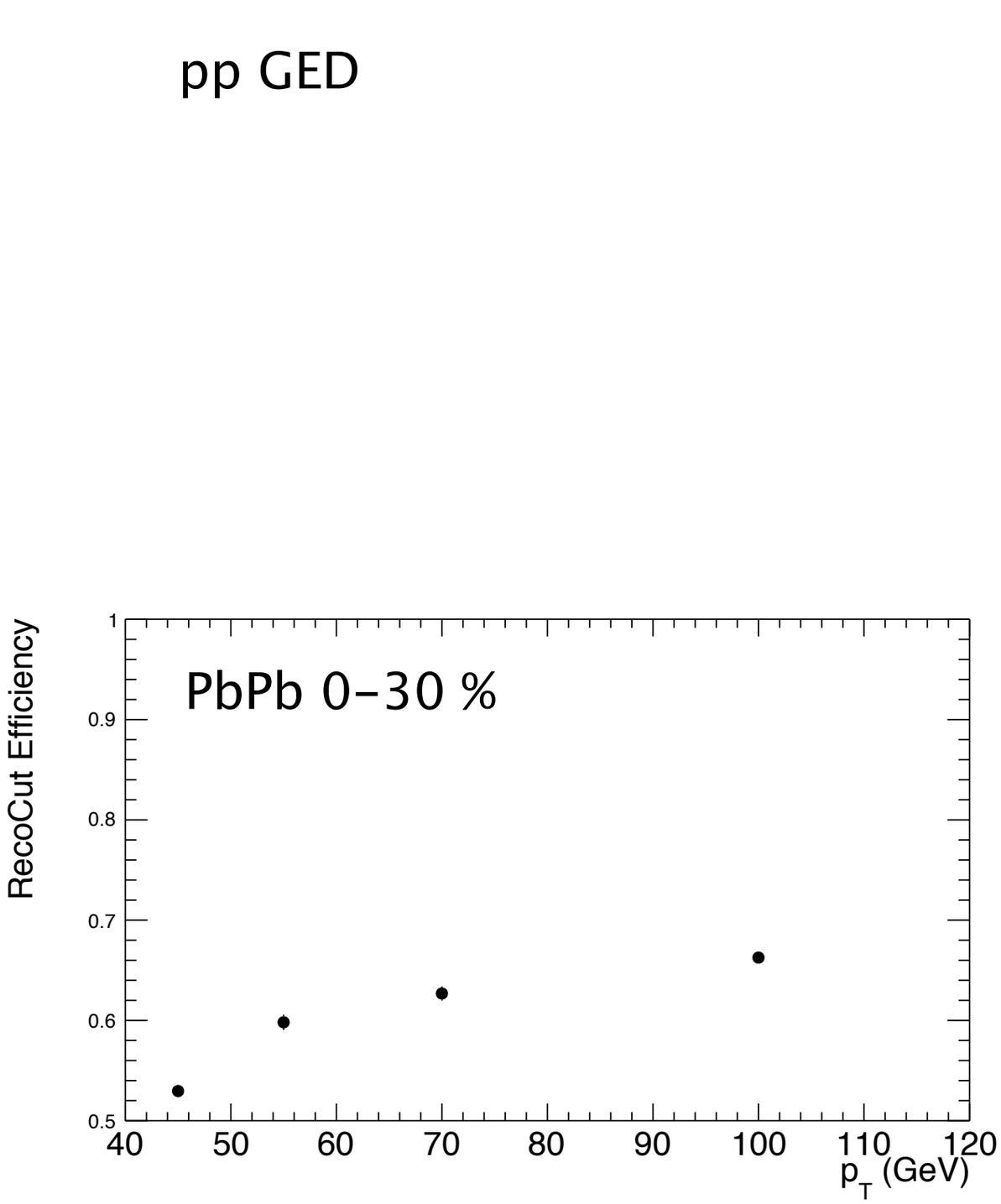


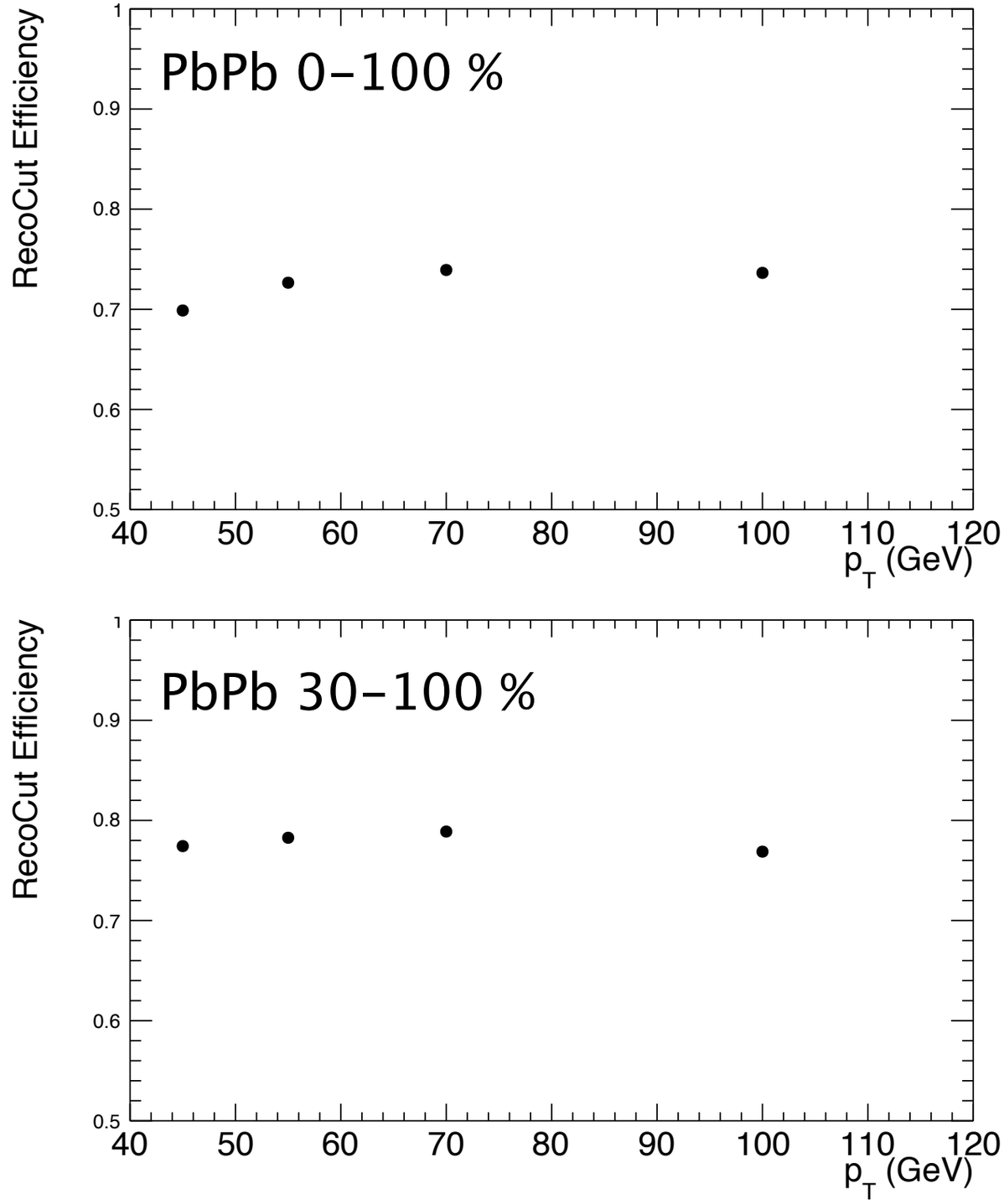


- numerator(pbpb) = (sumIso<1) && (genMatched && pid=22 && genIso<5)
- denominator = (pid=22 && genIso<5)

Total Efficiency : dir+frag photons

pp GED

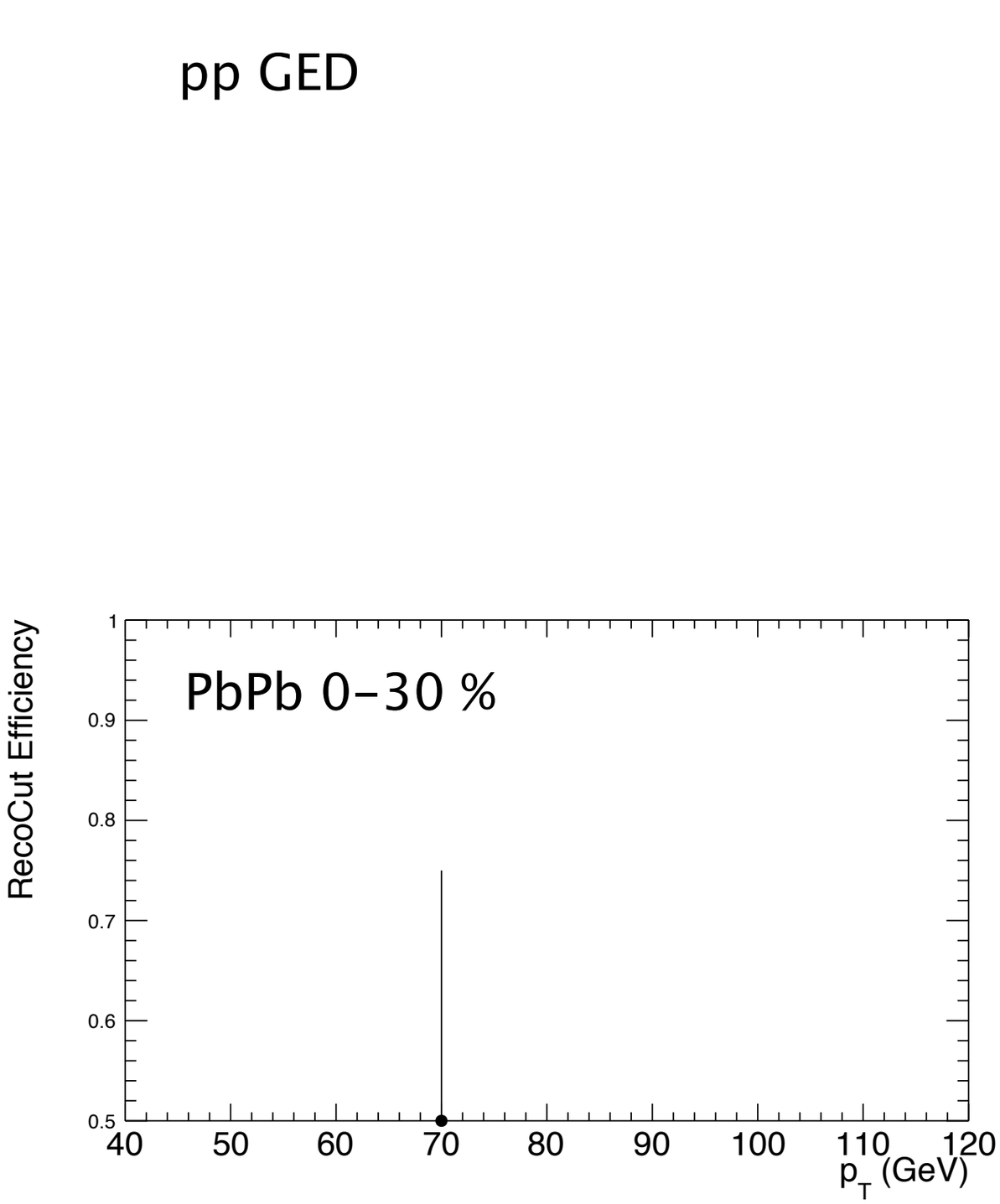


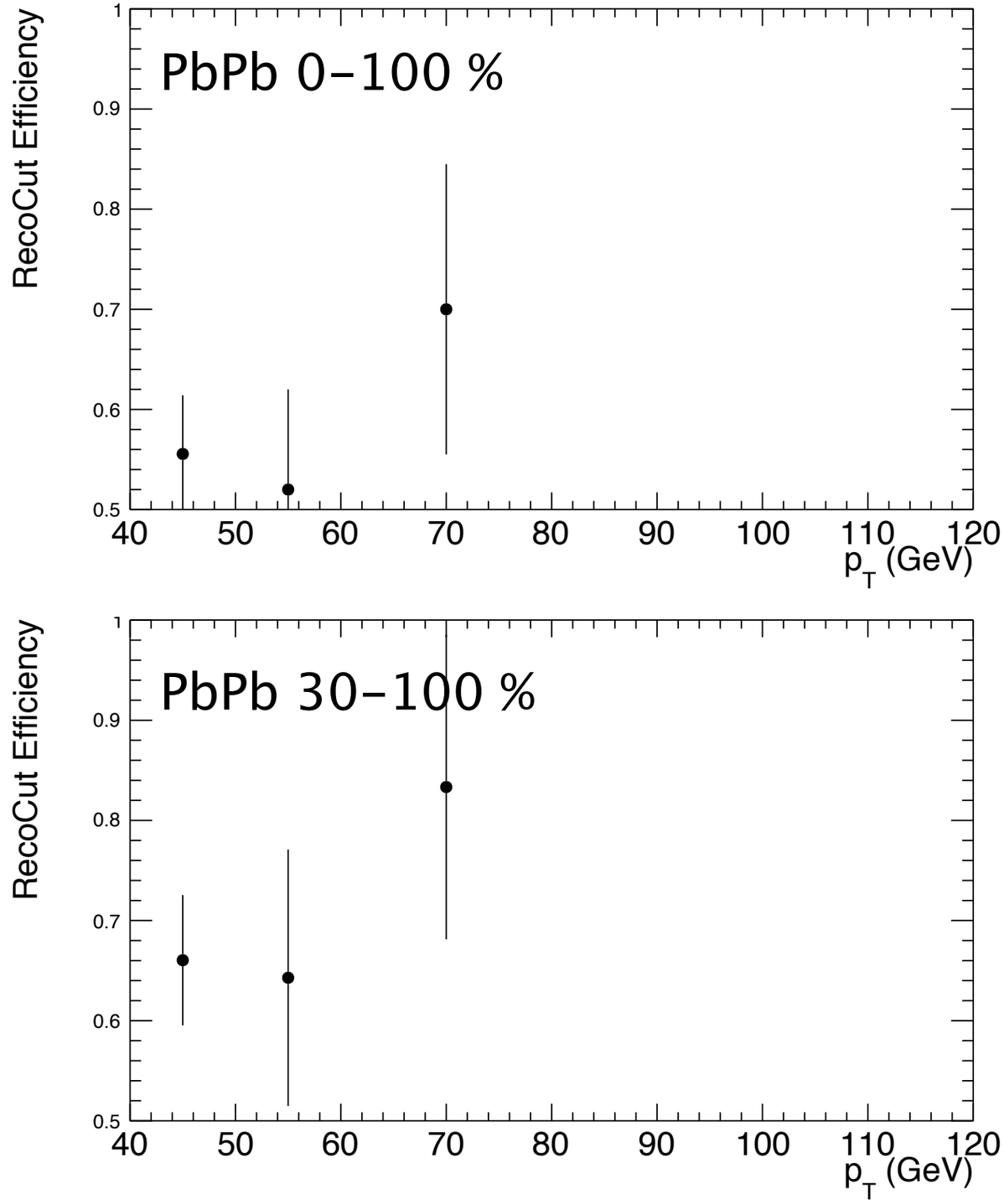


- denominator = (pid=22 && genIso<5 && **(genMomId<=22 || genMomId==-999)**)

Total Efficiency : decay photons

pp GED

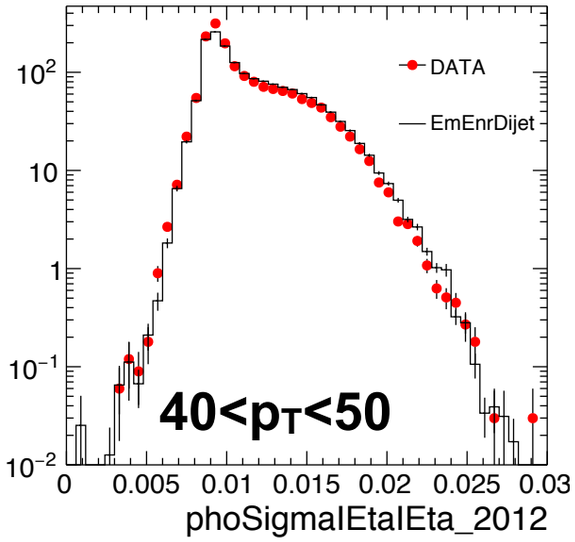


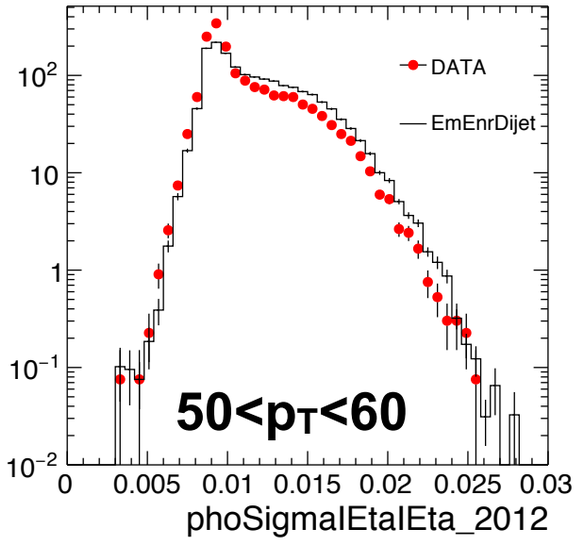


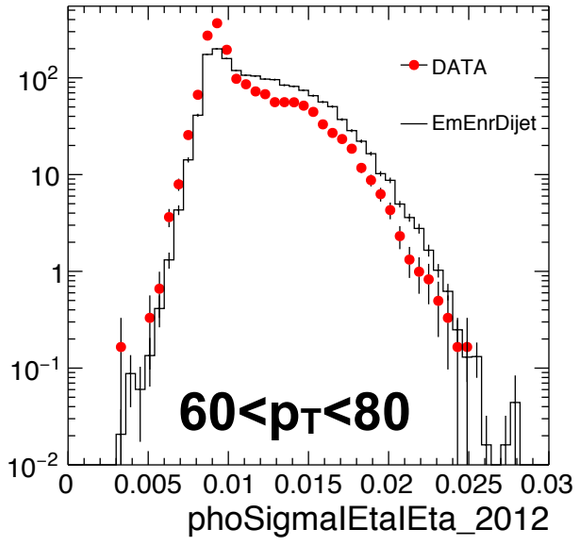
- little entries
- denominator = (pid=22 && genIso<5 && **(genMomId>22)**)

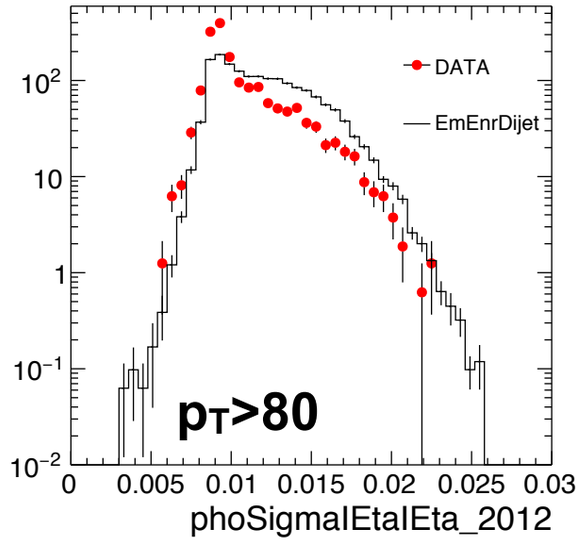
Sideband cut optimisation

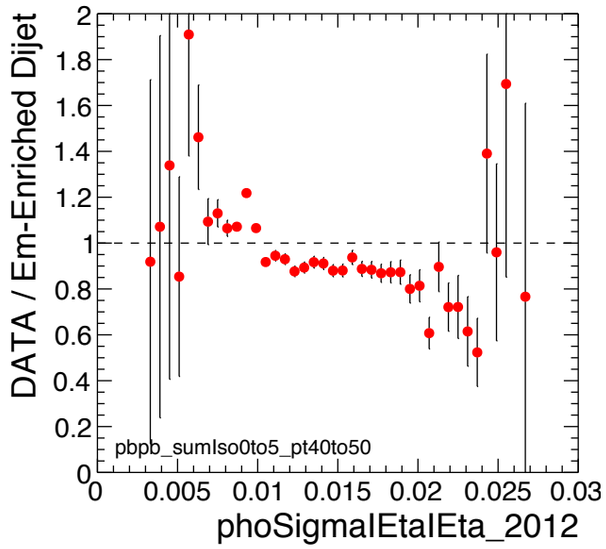
Sideband cut dependence

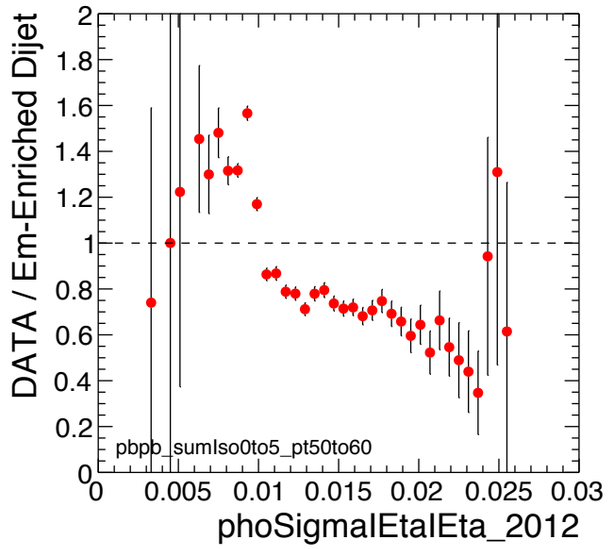


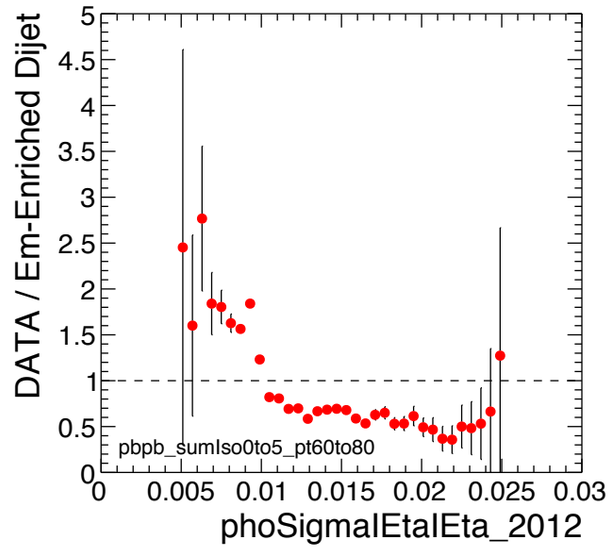


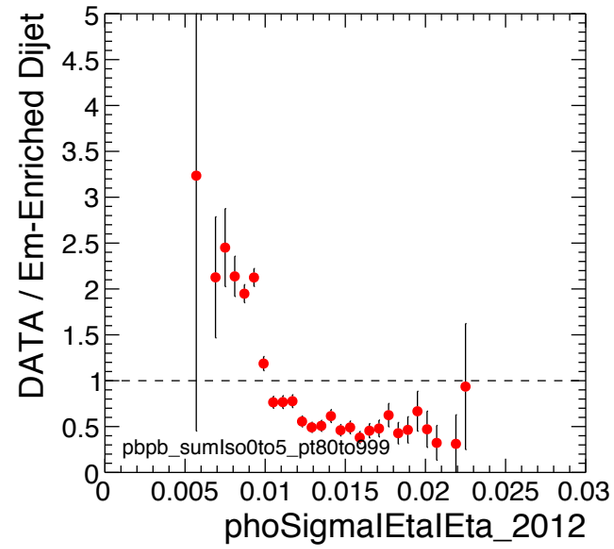






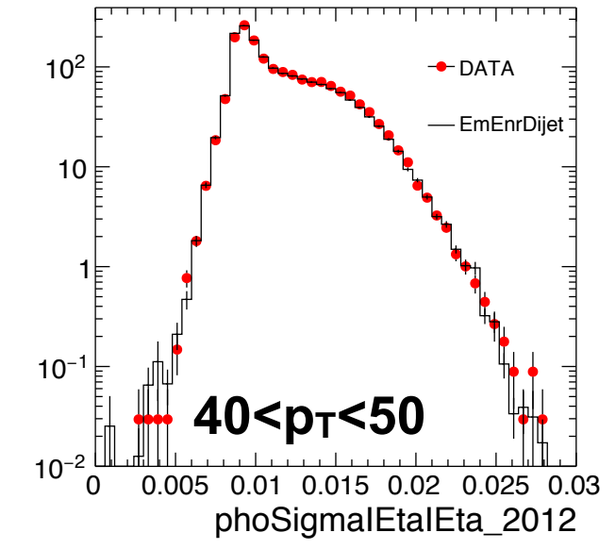


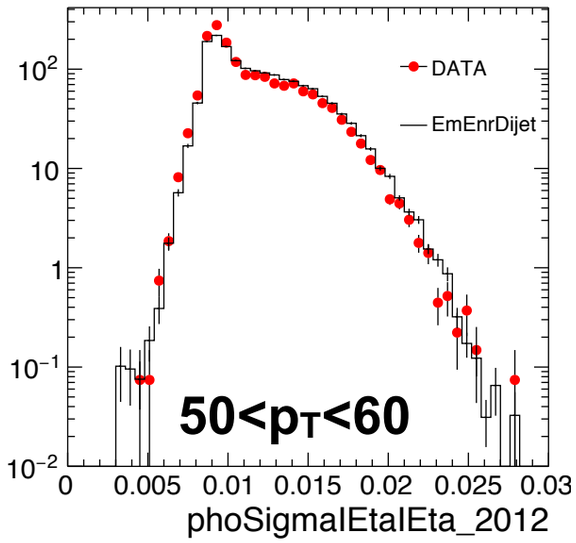


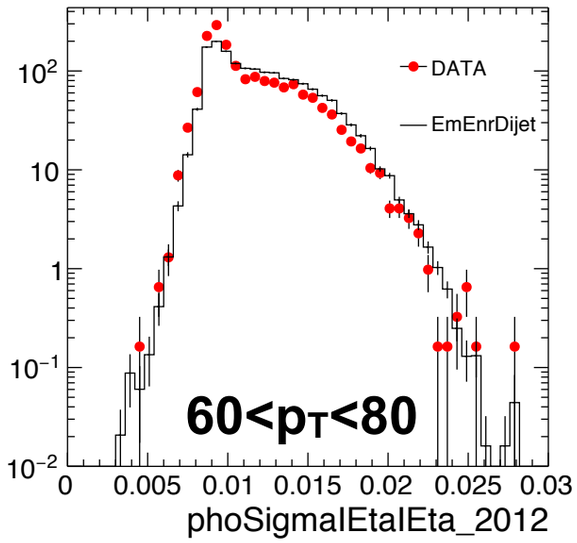


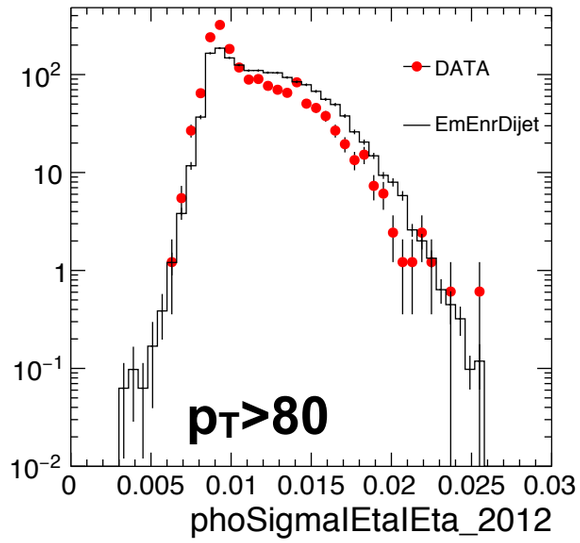
- **DATA Cuts**
  - |eta|<1.44
  - pcollisionEventSelection (pBeamScrapingFilter && pPAprimaryVertexFilter for pp)
  - Spike & hotspot rejection
  - Sideband cut : (sumIso>0) && (sumIso<5) && phoHoverE<0.1(0.05 for pp)
- **MC Cuts**
  - genMatched
  - !(mcCalIsoDR04<5 && abs(mcPID) = 22 && (abs(genMomPID<=22) || genMomPID=-999)) && h/e<0.1

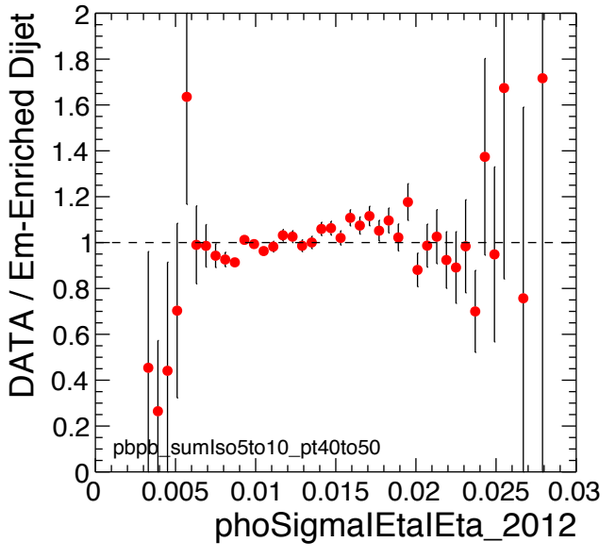
Sideband cut dependence

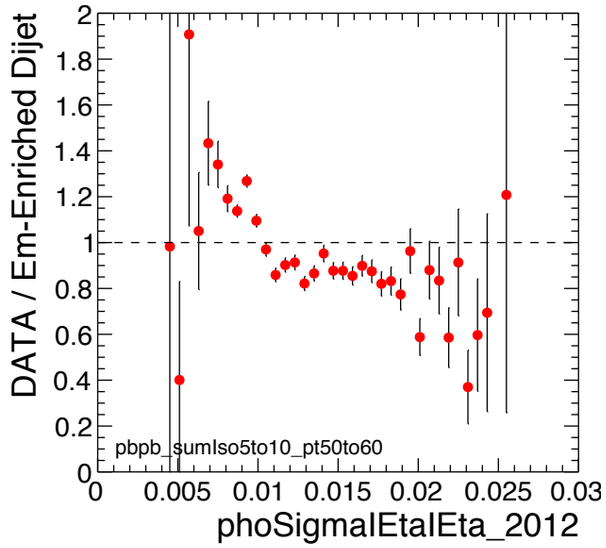


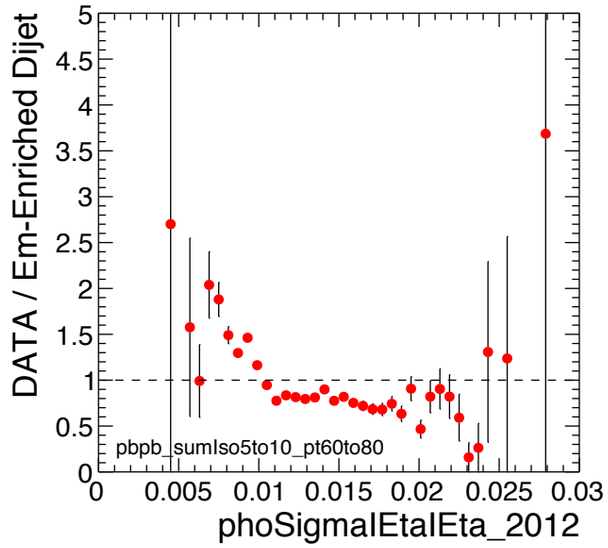


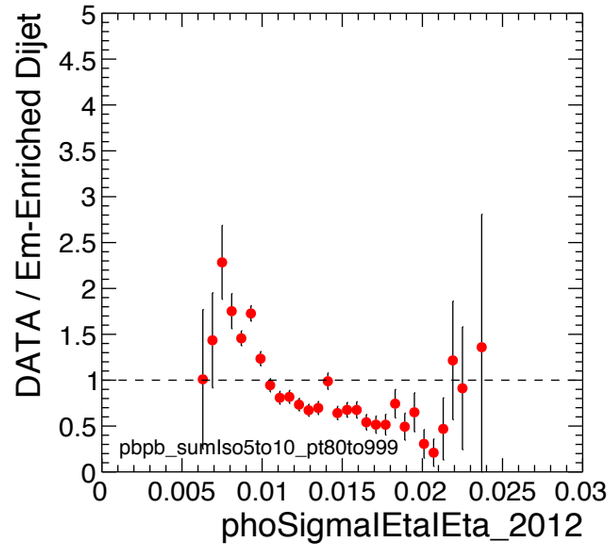






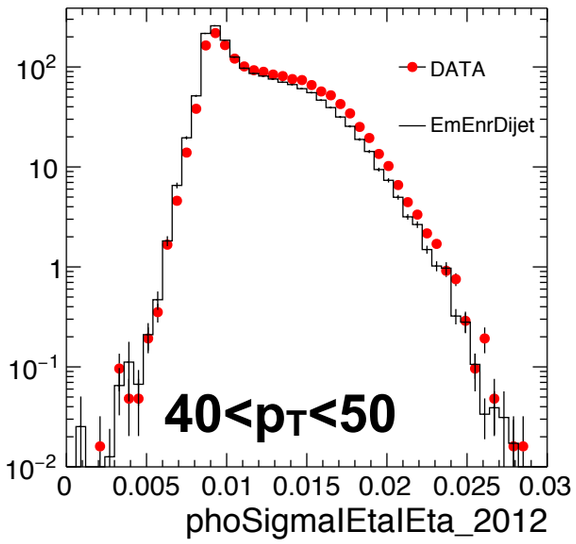


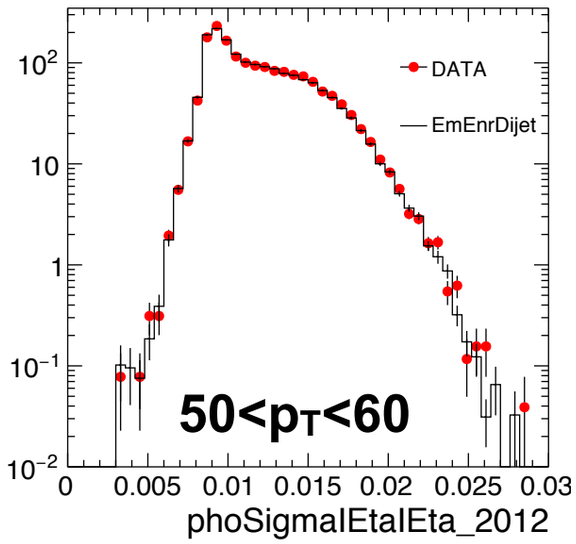


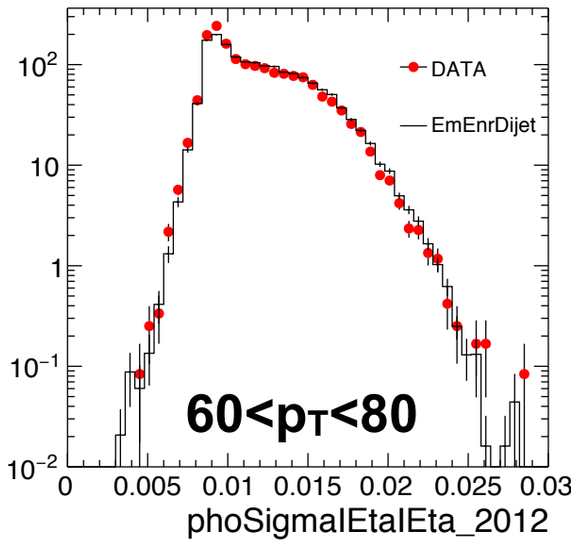


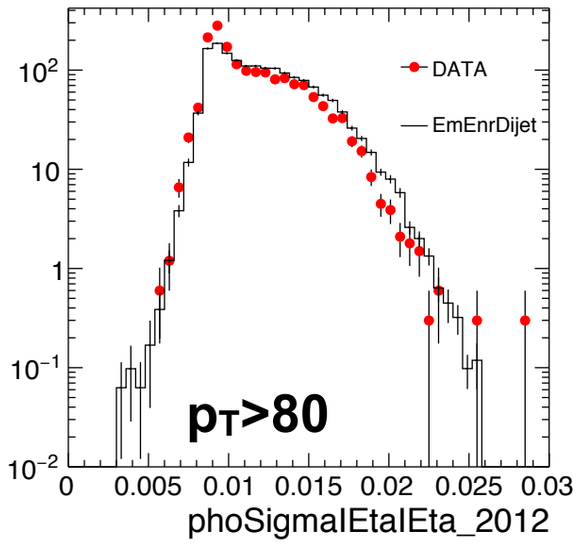
- **DATA Cuts**
  - |eta|<1.44
  - pcollisionEventSelection (pBeamScrapingFilter && pPAprimaryVertexFilter for pp)
  - Spike & hotspot rejection
  - Sideband cut : (sumIso>5) && (sumIso<10) && phoHoverE<0.1(0.05 for pp)
- **MC Cuts**
  - genMatched
  - !(mcCalIsoDR04<5 && abs(mcPID) = 22 && (abs(genMomPID<=22) || genMomPID=-999)) && h/e<0.1

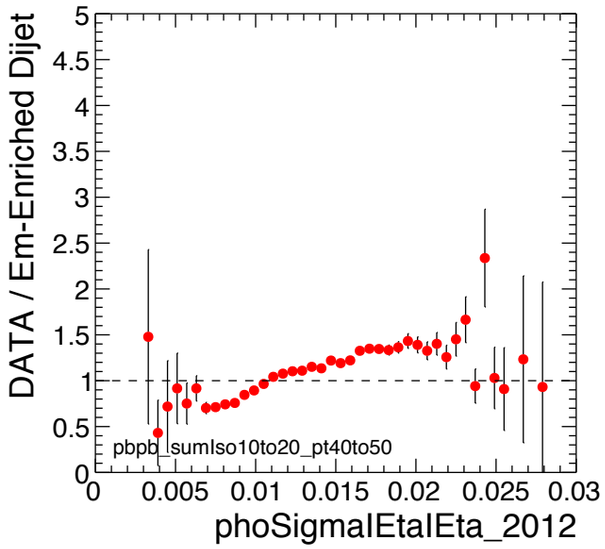
Sideband cut dependence

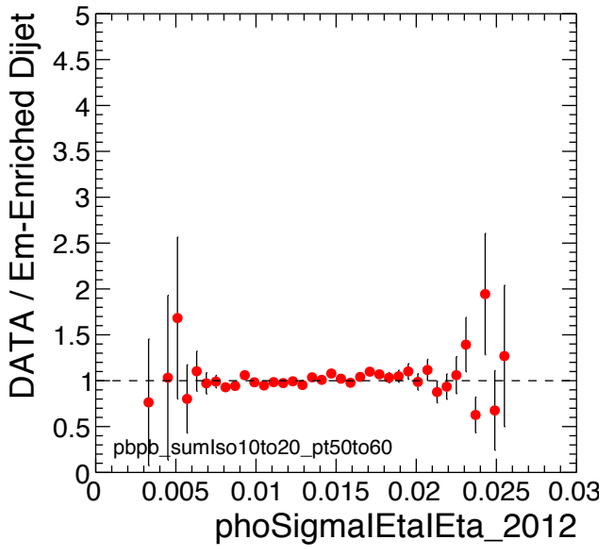


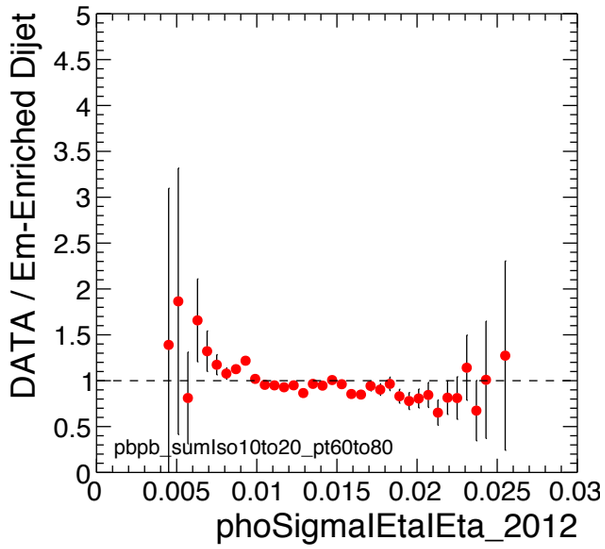


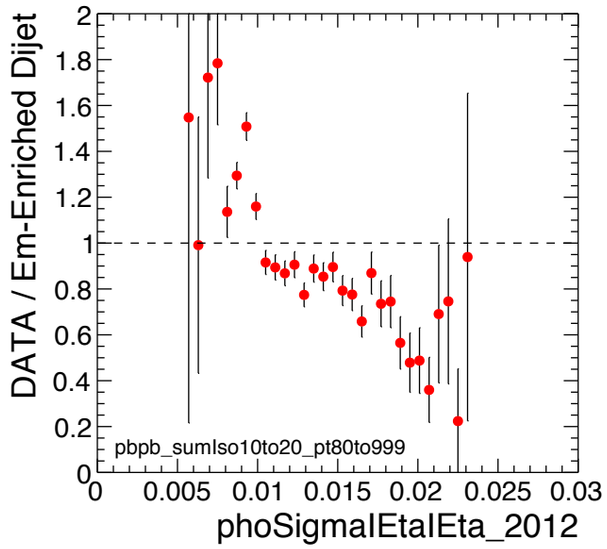






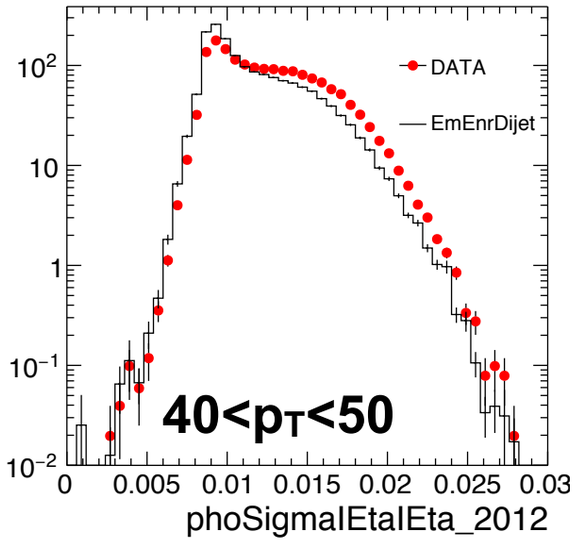


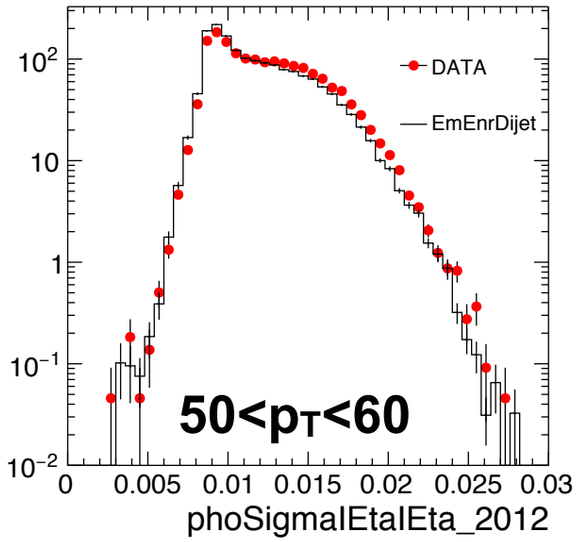


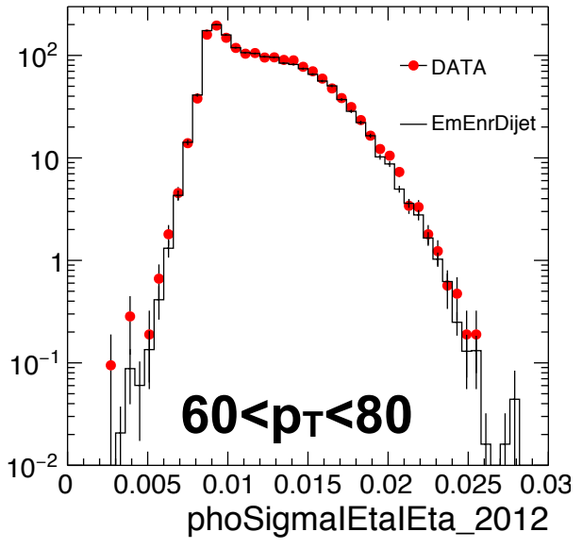


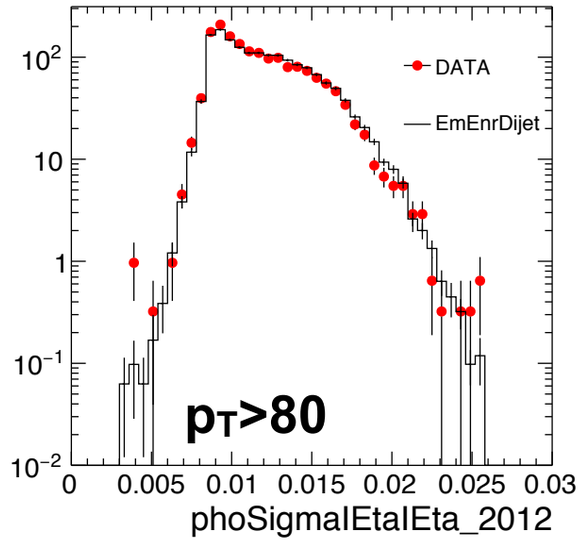
- **DATA Cuts**
  - |eta|<1.44
  - pcollisionEventSelection (pBeamScrapingFilter && pPAprimaryVertexFilter for pp)
  - Spike & hotspot rejection
  - Sideband cut : (sumIso>10) && (sumIso<20) && phoHoverE<0.1(0.05 for pp)
- **MC Cuts**
  - genMatched
  - !(mcCalIsoDR04<5 && abs(mcPID) = 22 && (abs(genMomPID<=22) || genMomPID=-999)) && h/e<0.1

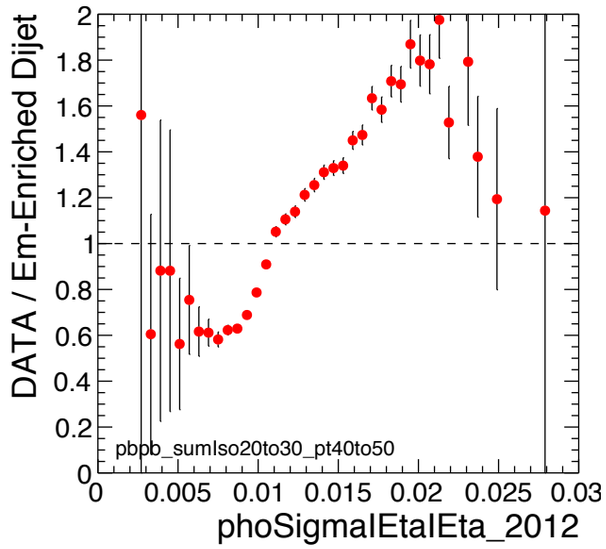
Sideband cut dependence

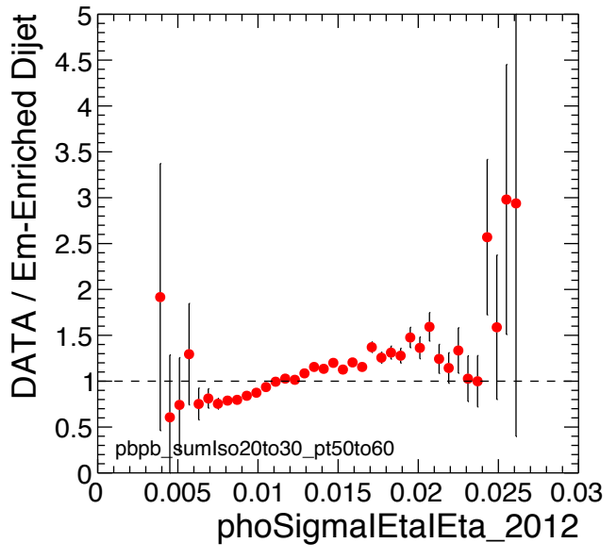


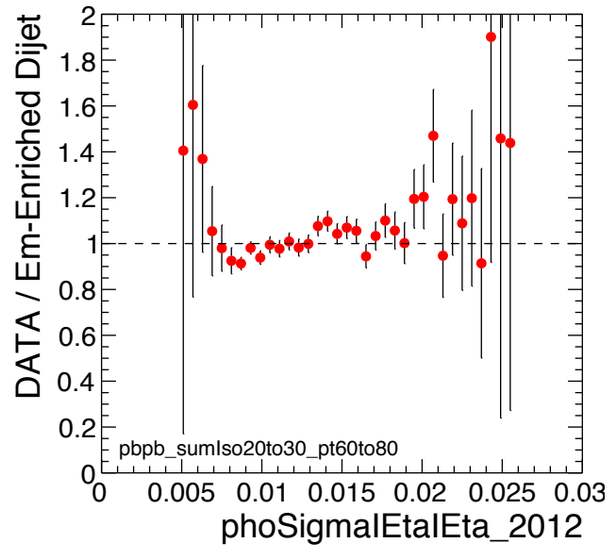


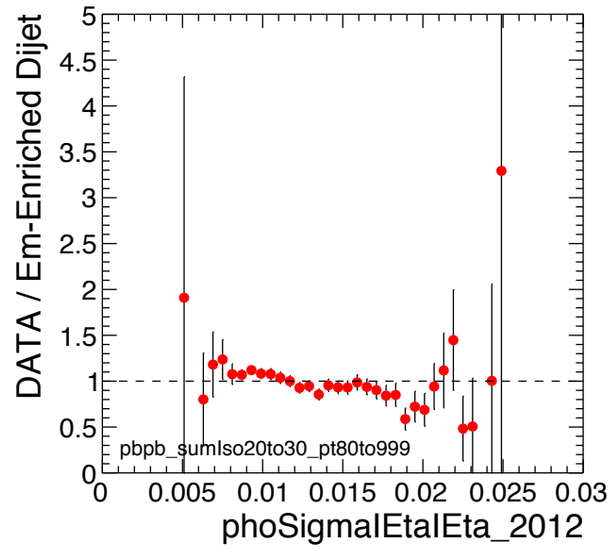












- **DATA Cuts**
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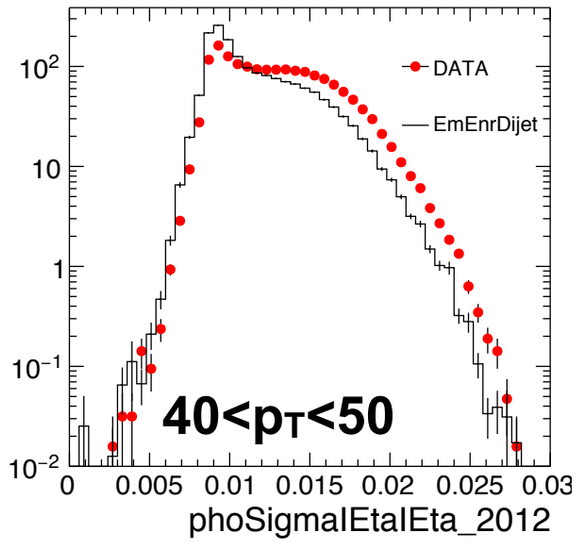
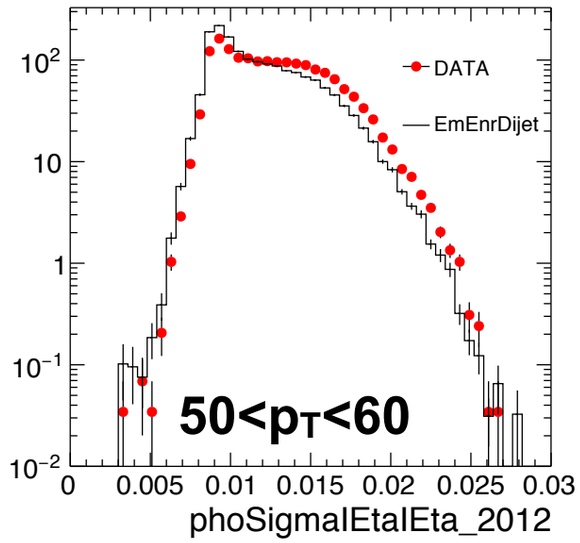
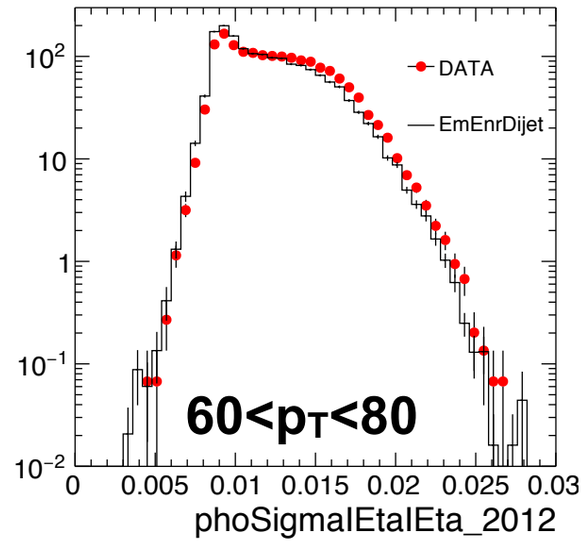
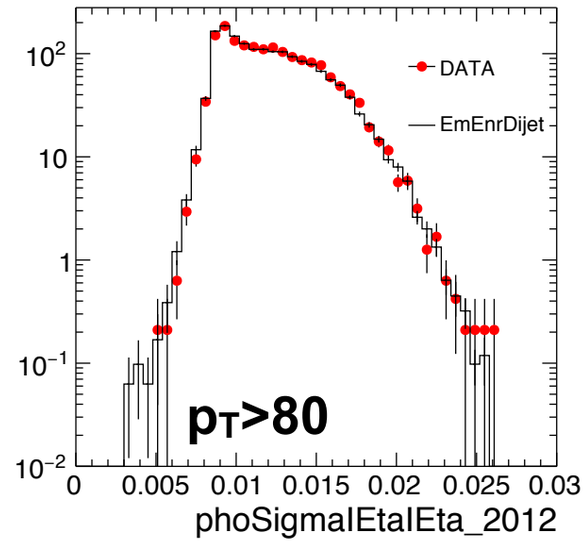
  - pcollisionEventSelection (pBeamScrapingFilter && pPAprimaryVertexFilter for pp)
  - Spike & hotspot rejection
  - Sideband cut : (sumIso>20) && (sumIso<30) && phoHoverE<0.1(0.05 for pp)
- **MC Cuts**
  - genMatched
  - !(mcCalIsoDR04<5 && abs(mcPID) = 22 && (abs(genMomPID<=22) || genMomPID=-999)) && h/e<0.1

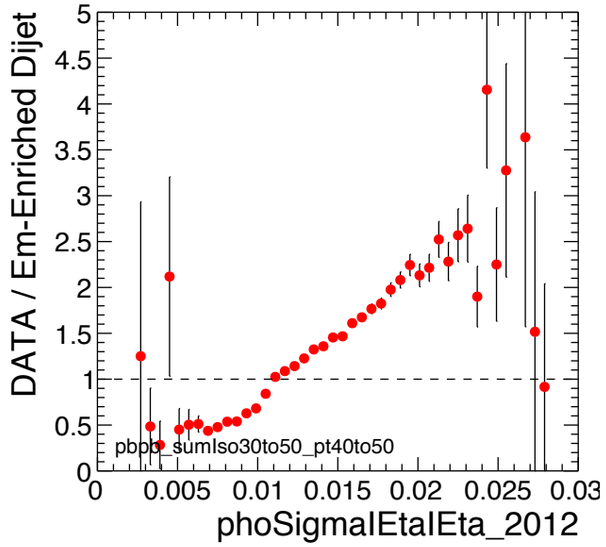
Sideband cut dependence

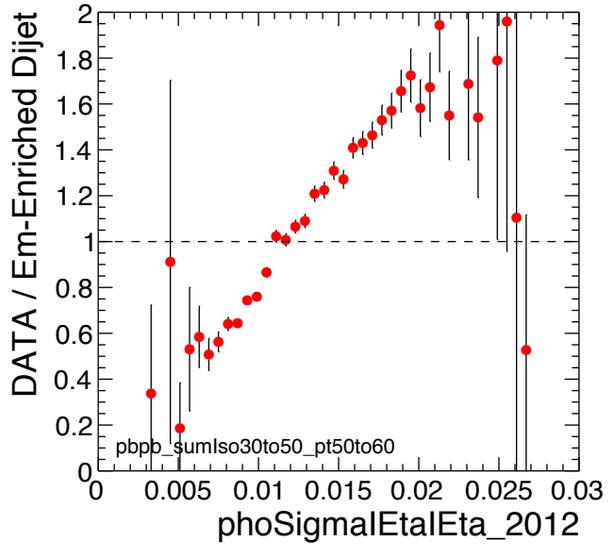


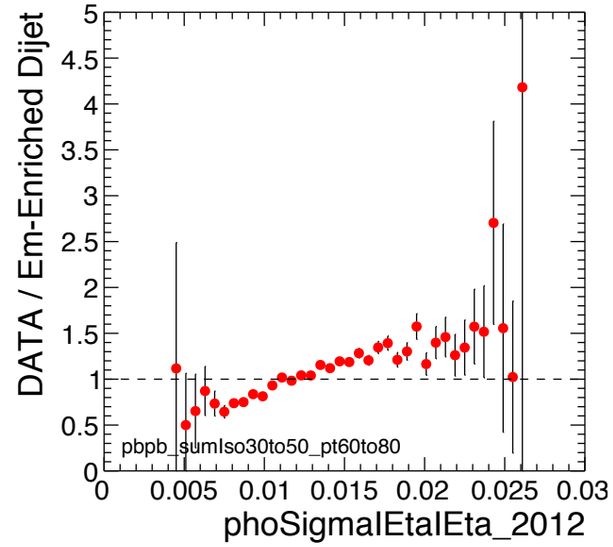


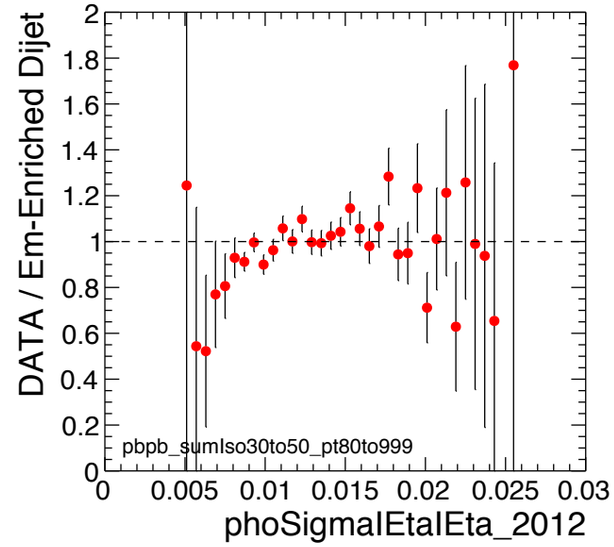






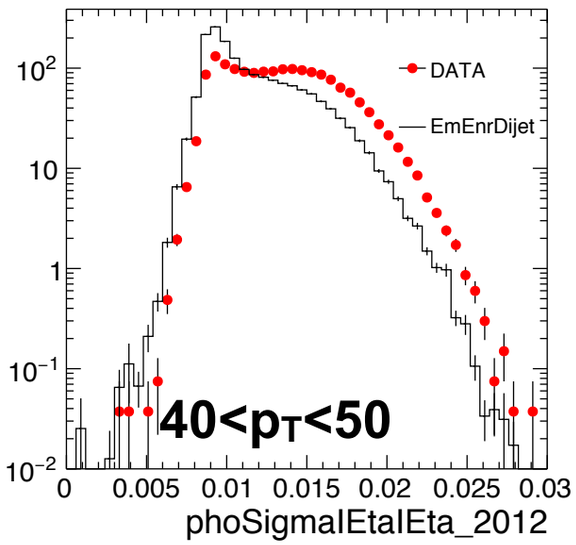


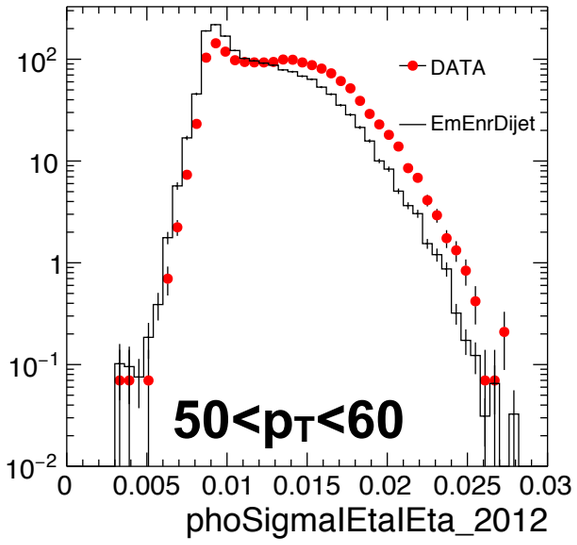


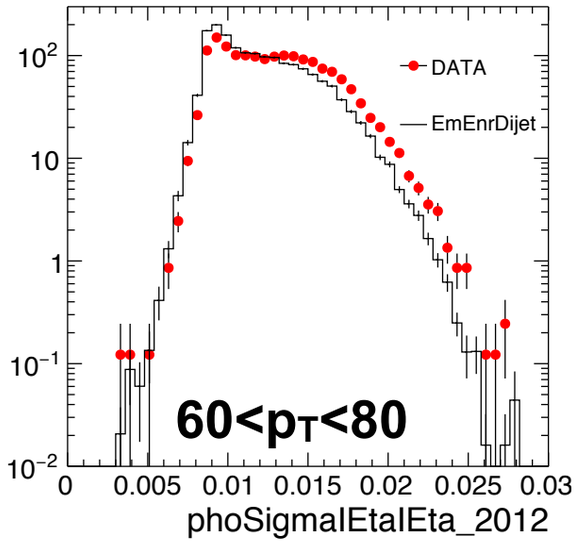


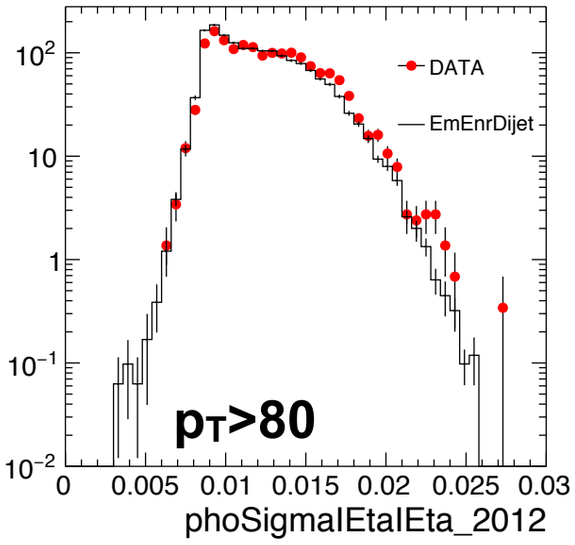
- **DATA Cuts**
  - |eta|<1.44
  - pcollisionEventSelection (pBeamScrapingFilter && pPAprimaryVertexFilter for pp)
  - Spike & hotspot rejection
  - Sideband cut : (sumIso>30) && (sumIso<50) && phoHoverE<0.1(0.05 for pp)
- **MC Cuts**
  - genMatched
  - !(mcCalIsoDR04<5 && abs(mcPID) = 22 && (abs(genMomPID<=22) || genMomPID=-999)) && h/e<0.1

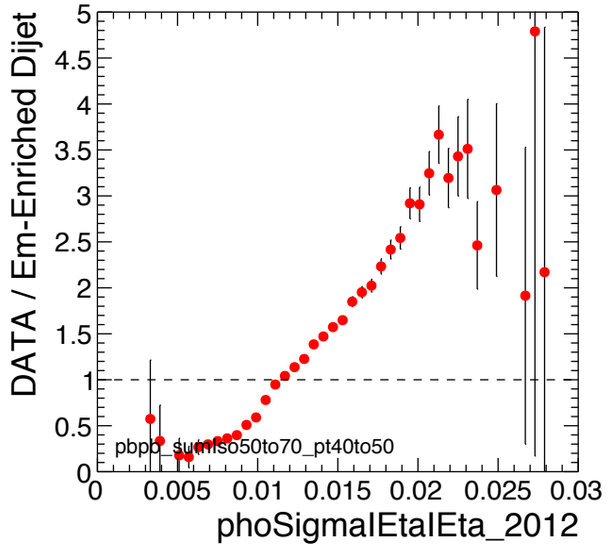
Sideband cut dependence

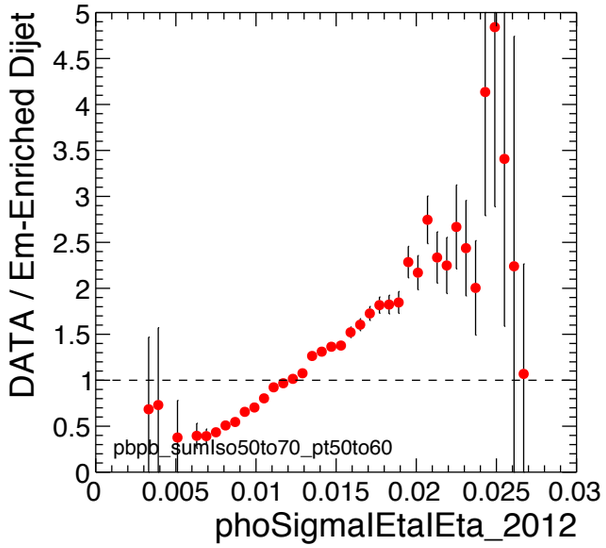


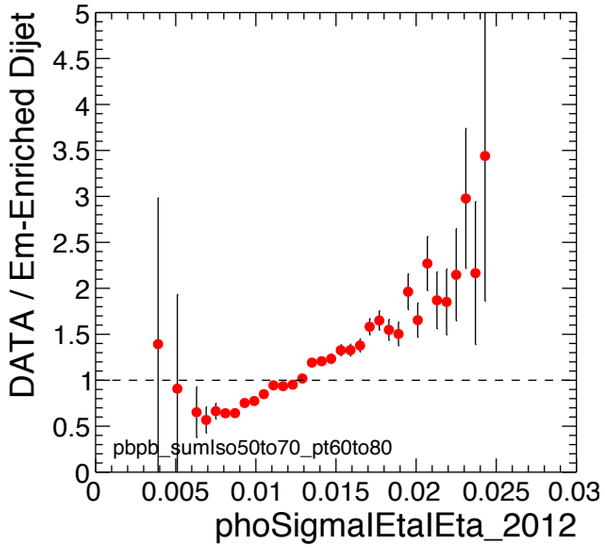


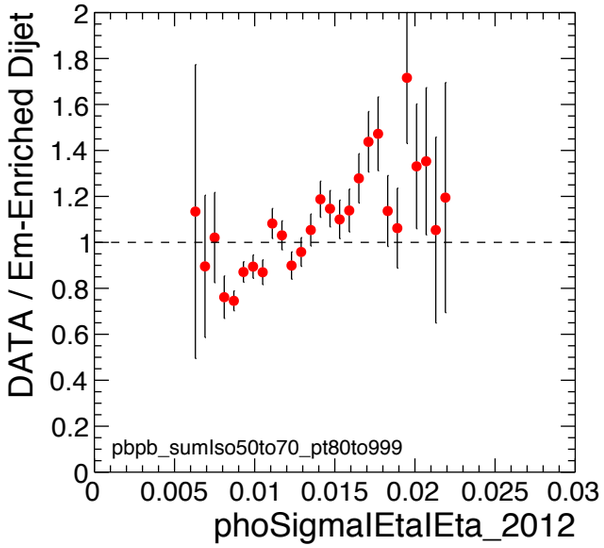






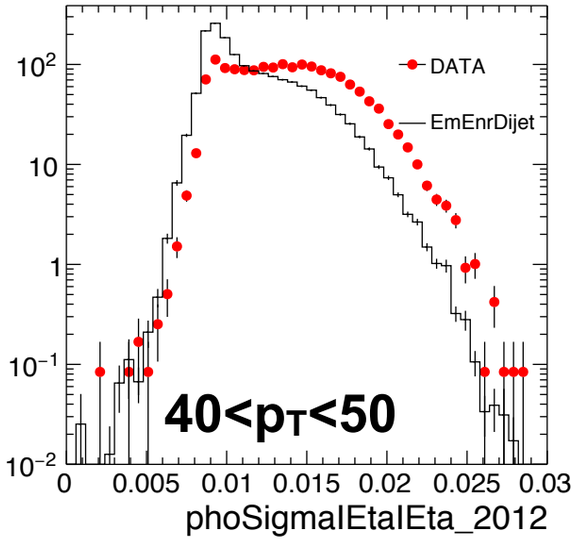


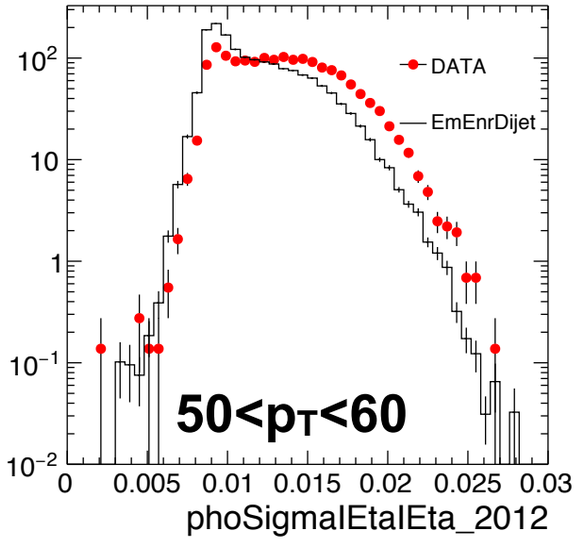


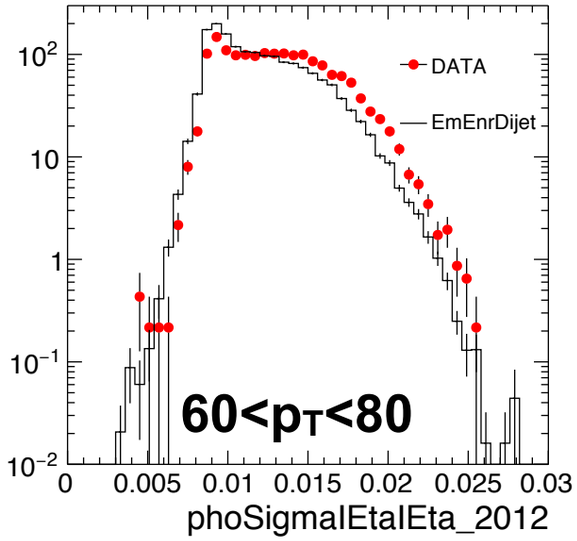


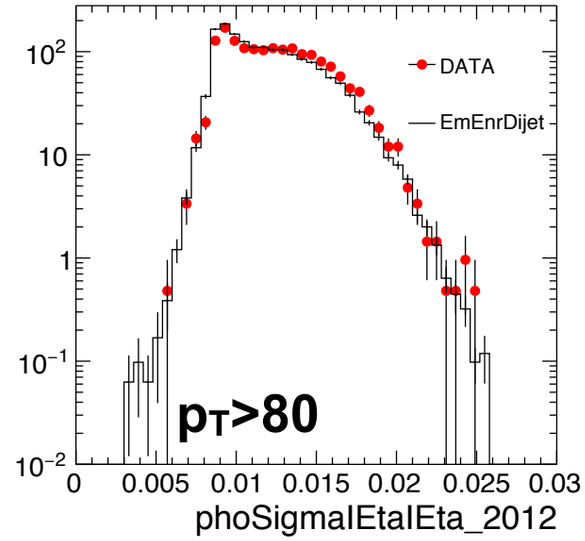
- **DATA Cuts**
  - |eta|<1.44
  - pcollisionEventSelection (pBeamScrapingFilter && pPAprimaryVertexFilter for pp)
  - Spike & hotspot rejection
  - Sideband cut : (sumIso>50) && (sumIso<70) && phoHoverE<0.1(0.05 for pp)
- **MC Cuts**
  - genMatched
  - !(mcCalIsoDR04<5 && abs(mcPID) = 22 && (abs(genMomPID<=22) || genMomPID=-999)) && h/e<0.1

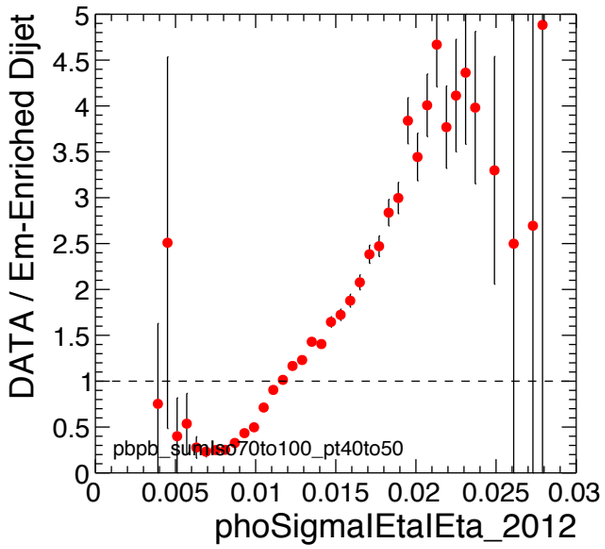
Sideband cut dependence

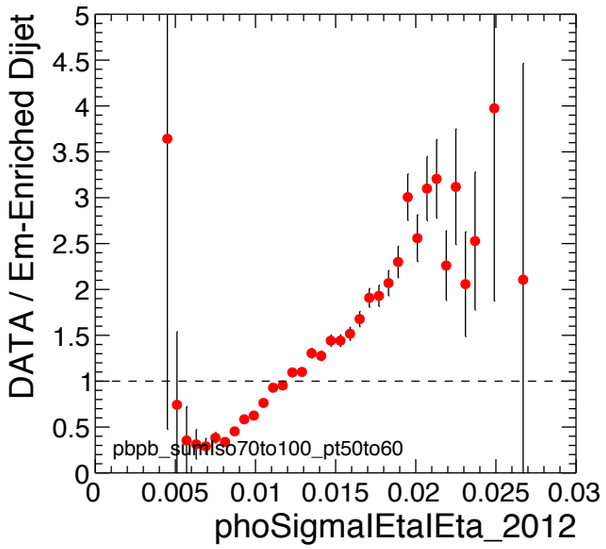


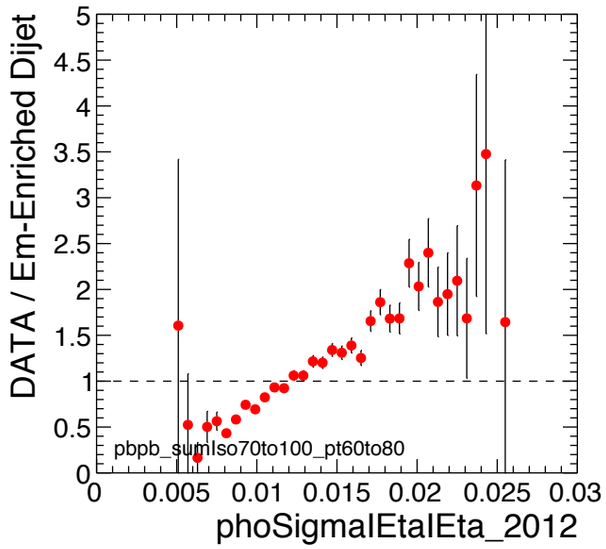


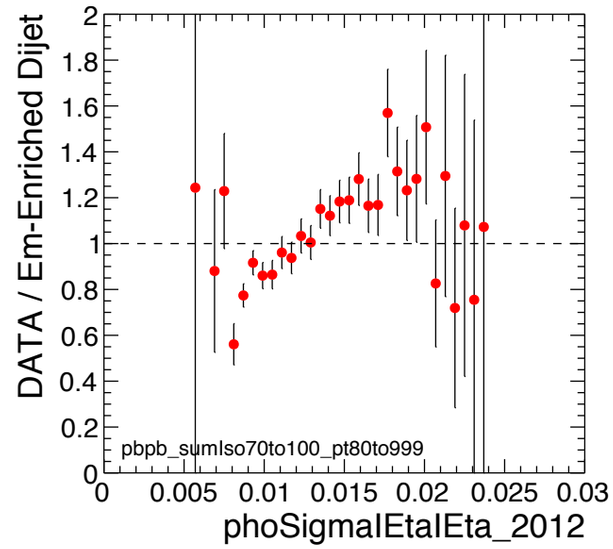








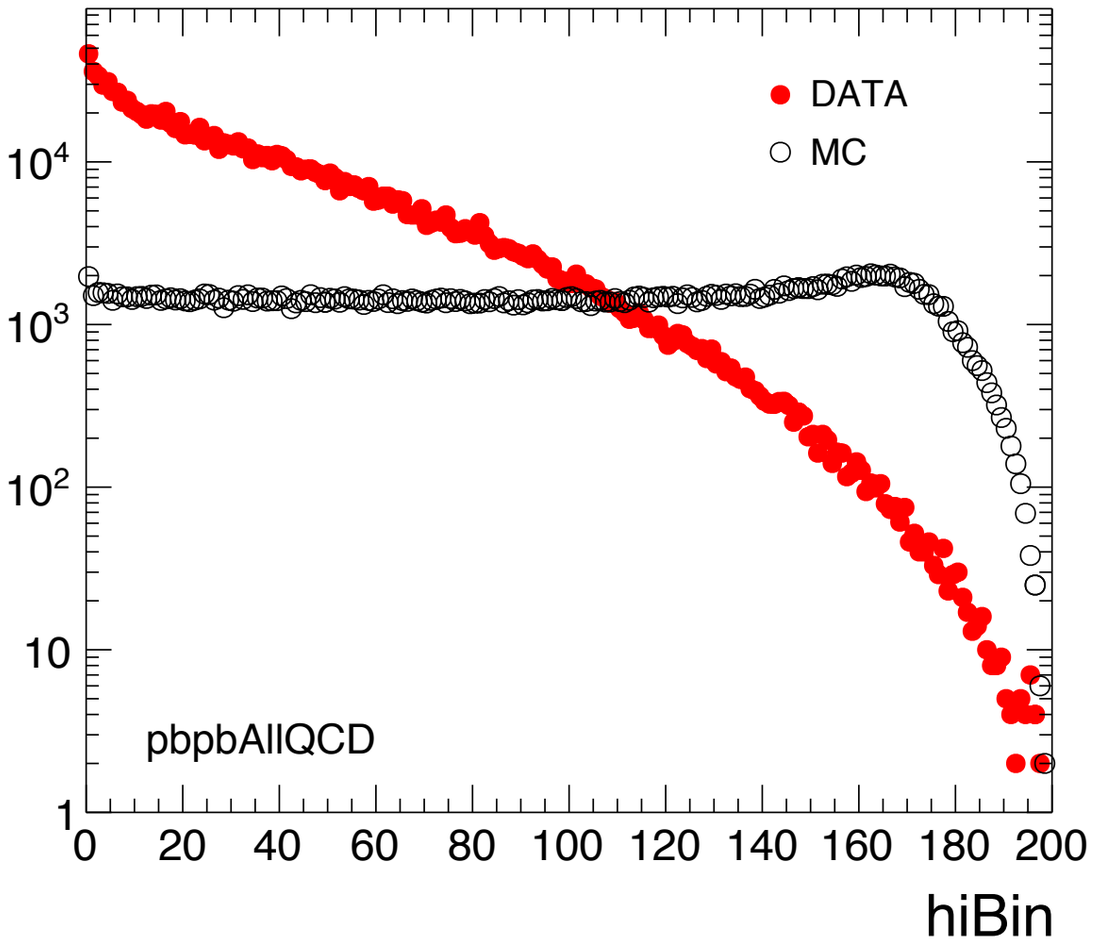


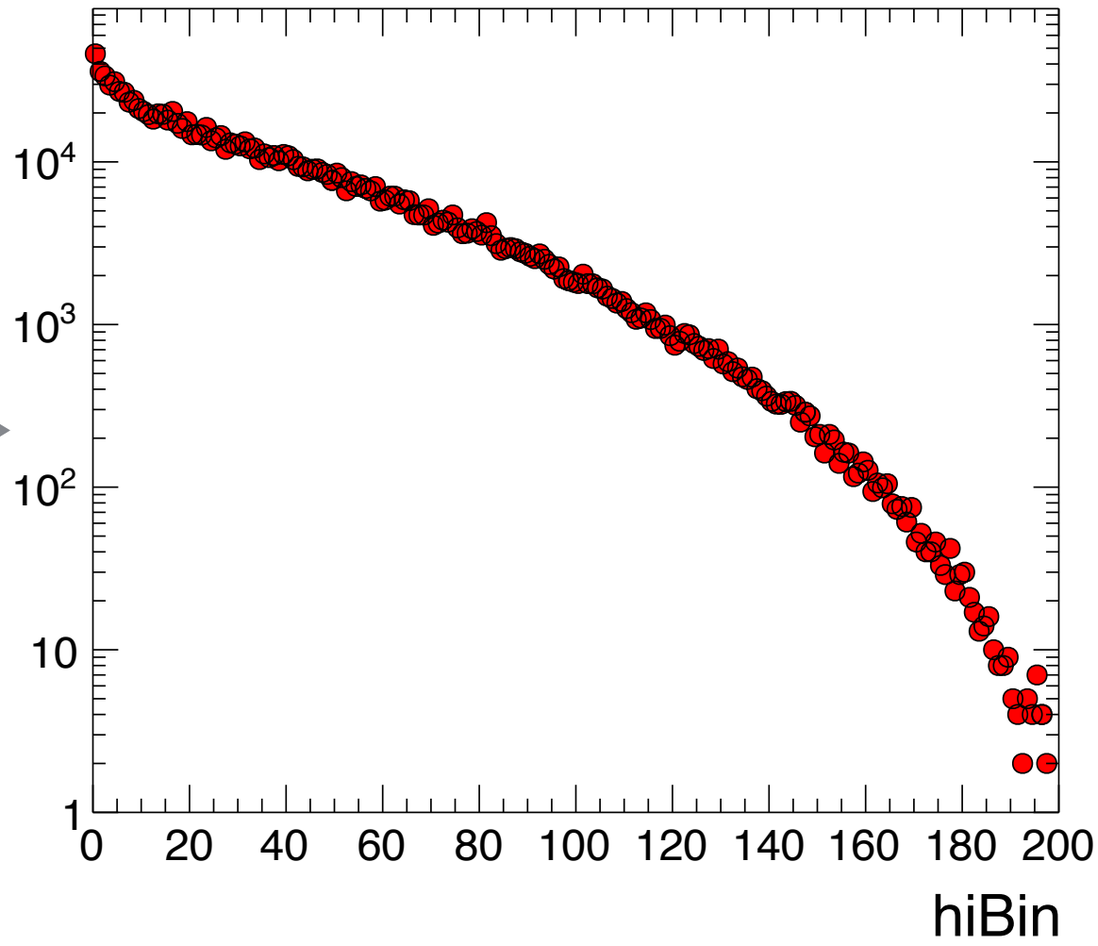


- **DATA Cuts**
  - |eta|<1.44
  - pcollisionEventSelection (pBeamScrapingFilter && pPAprimaryVertexFilter for pp)
  - Spike & hotspot rejection
  - Sideband cut : (sumIso>70) && (sumIso<100) && phoHoverE<0.1(0.05 for pp)
- **MC Cuts**
  - genMatched
  - !(mcCalIsoDR04<5 && abs(mcPID) = 22 && (abs(genMomPID<=22) || genMomPID=-999)) && h/e<0.1

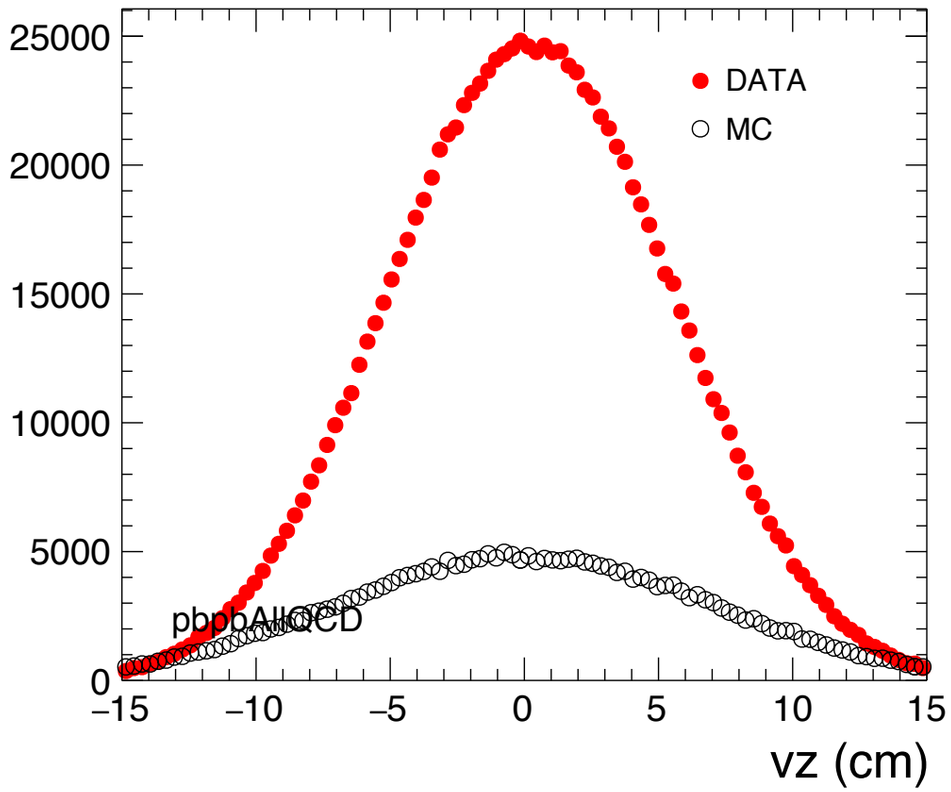
vertex & centrality reweighting

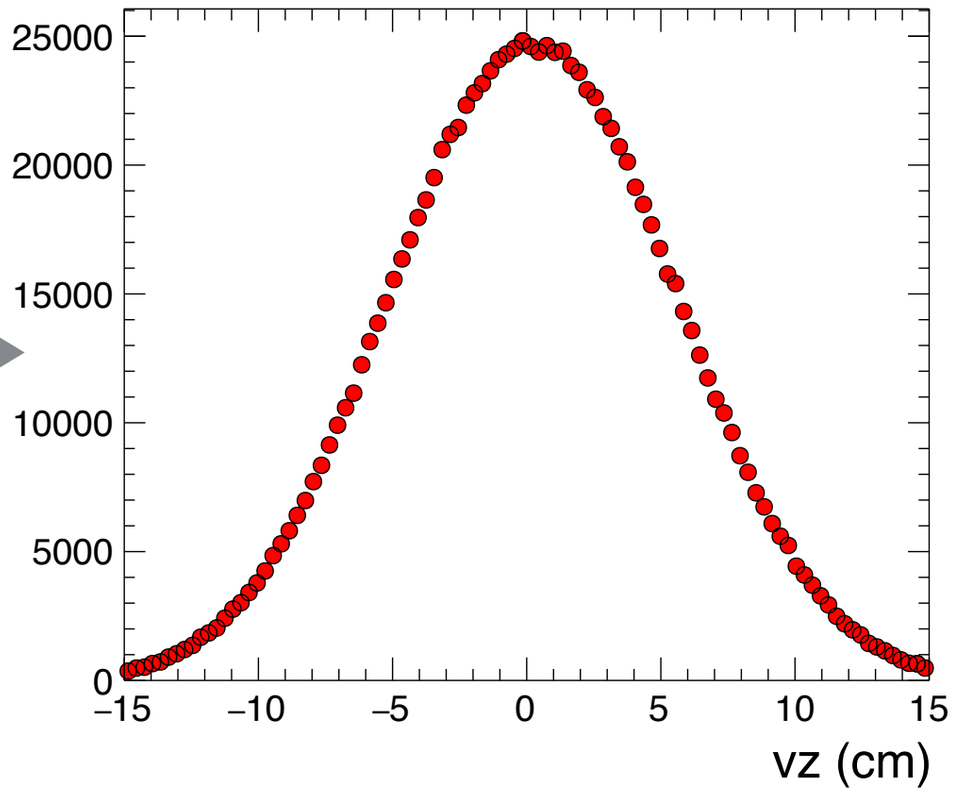
Centrality Reweight

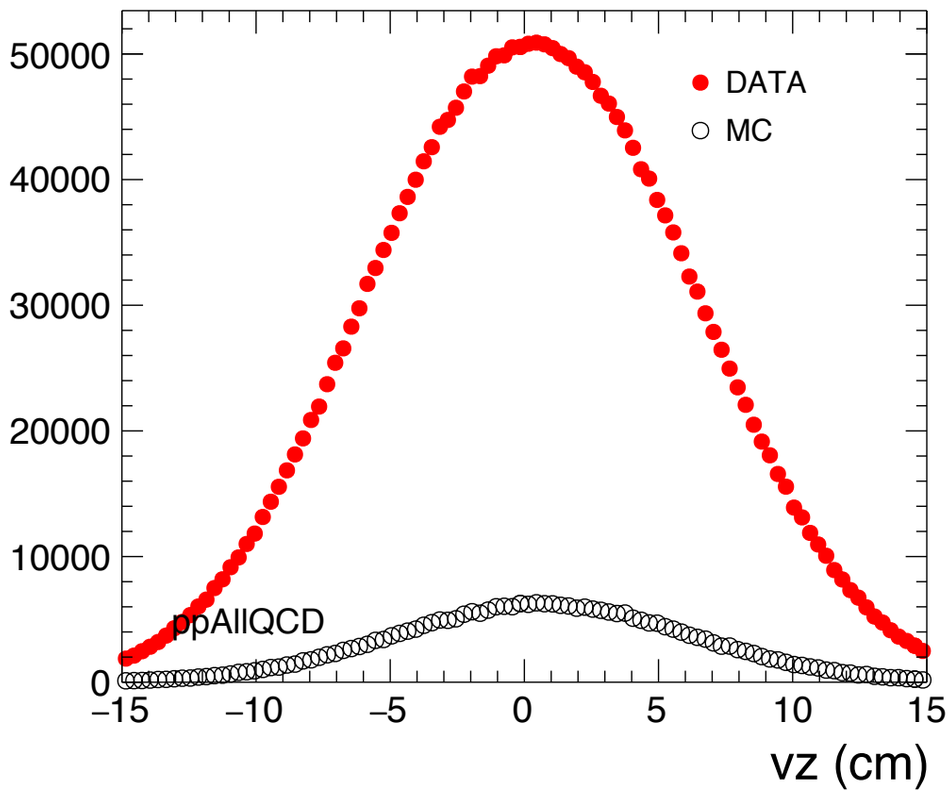


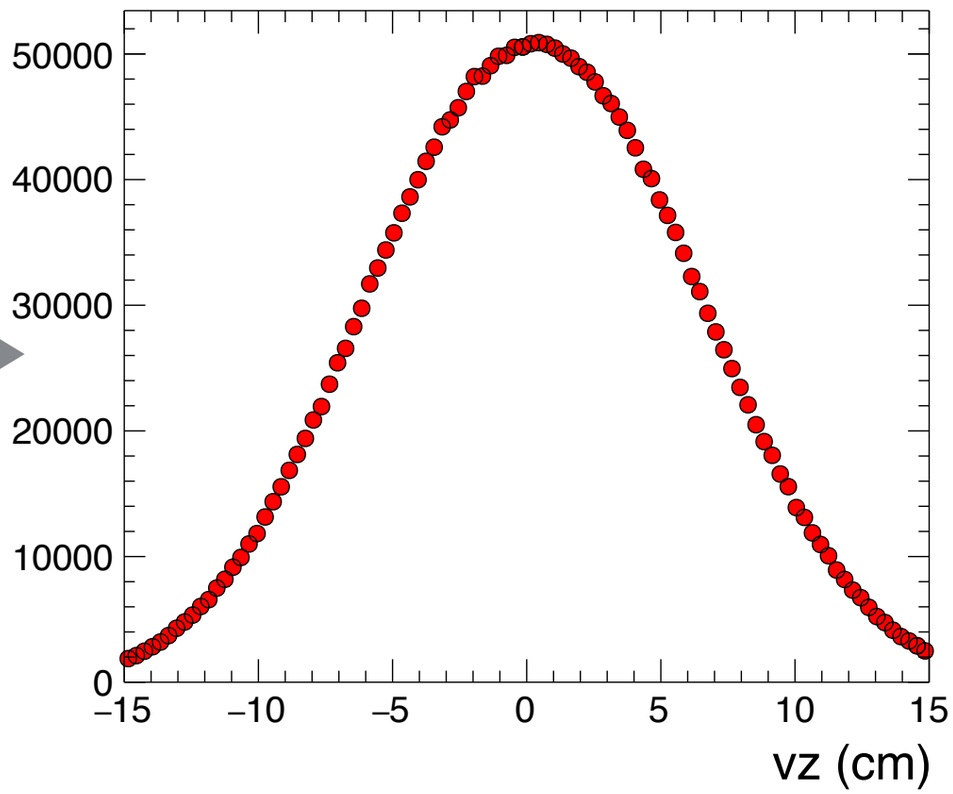


Vertex Reweight





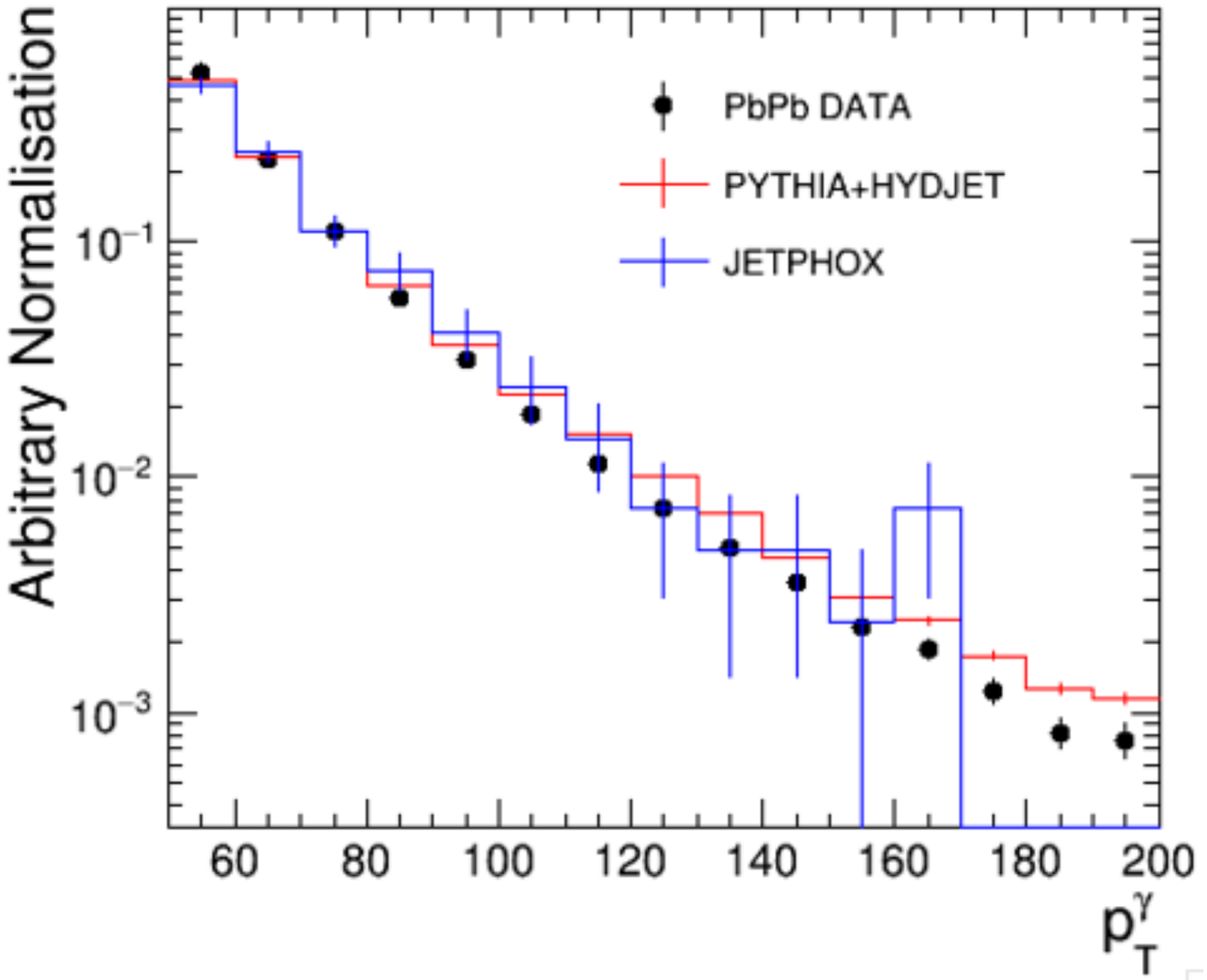




JETPHOX calculation

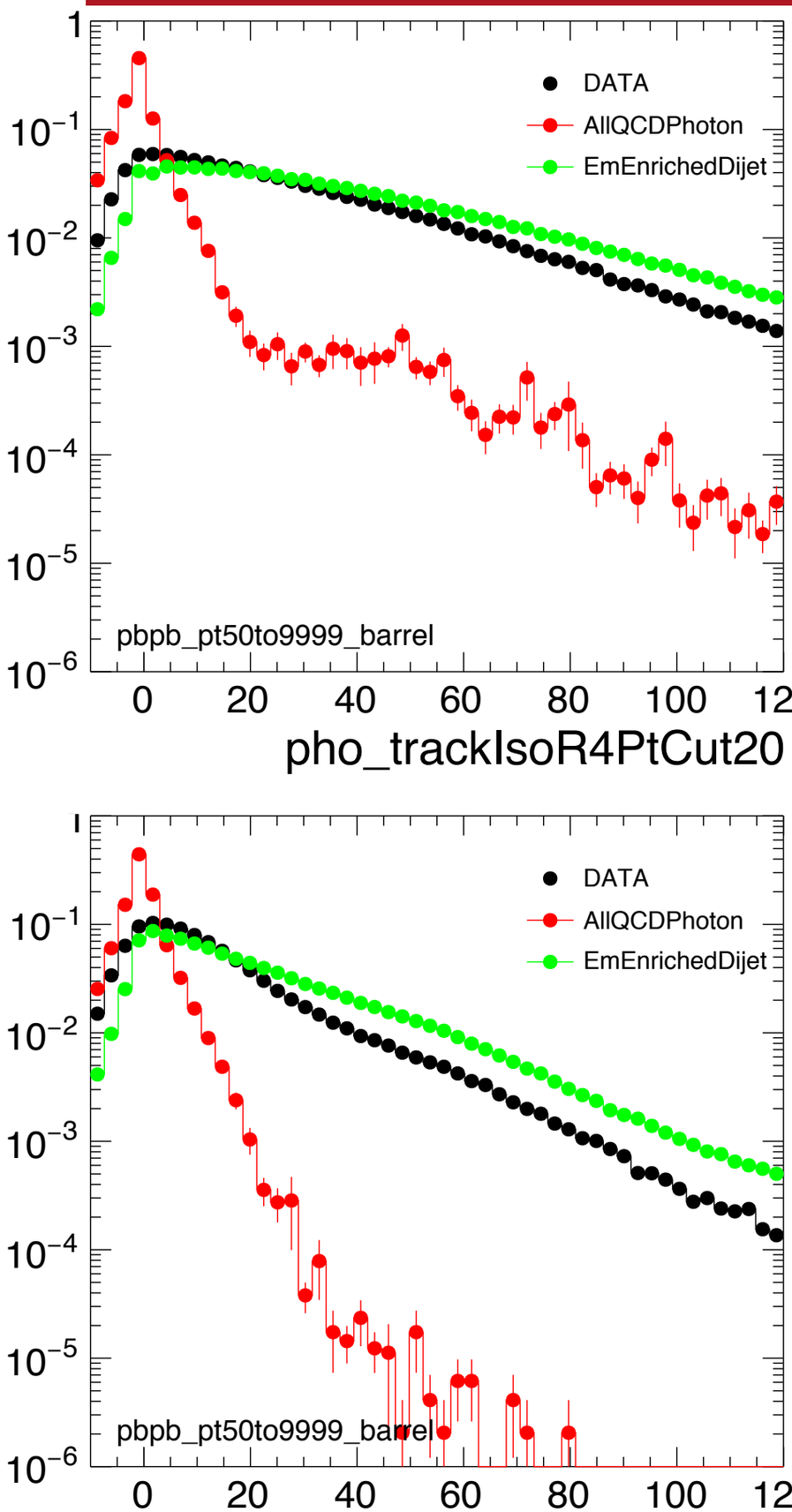
DATA and MC comparison

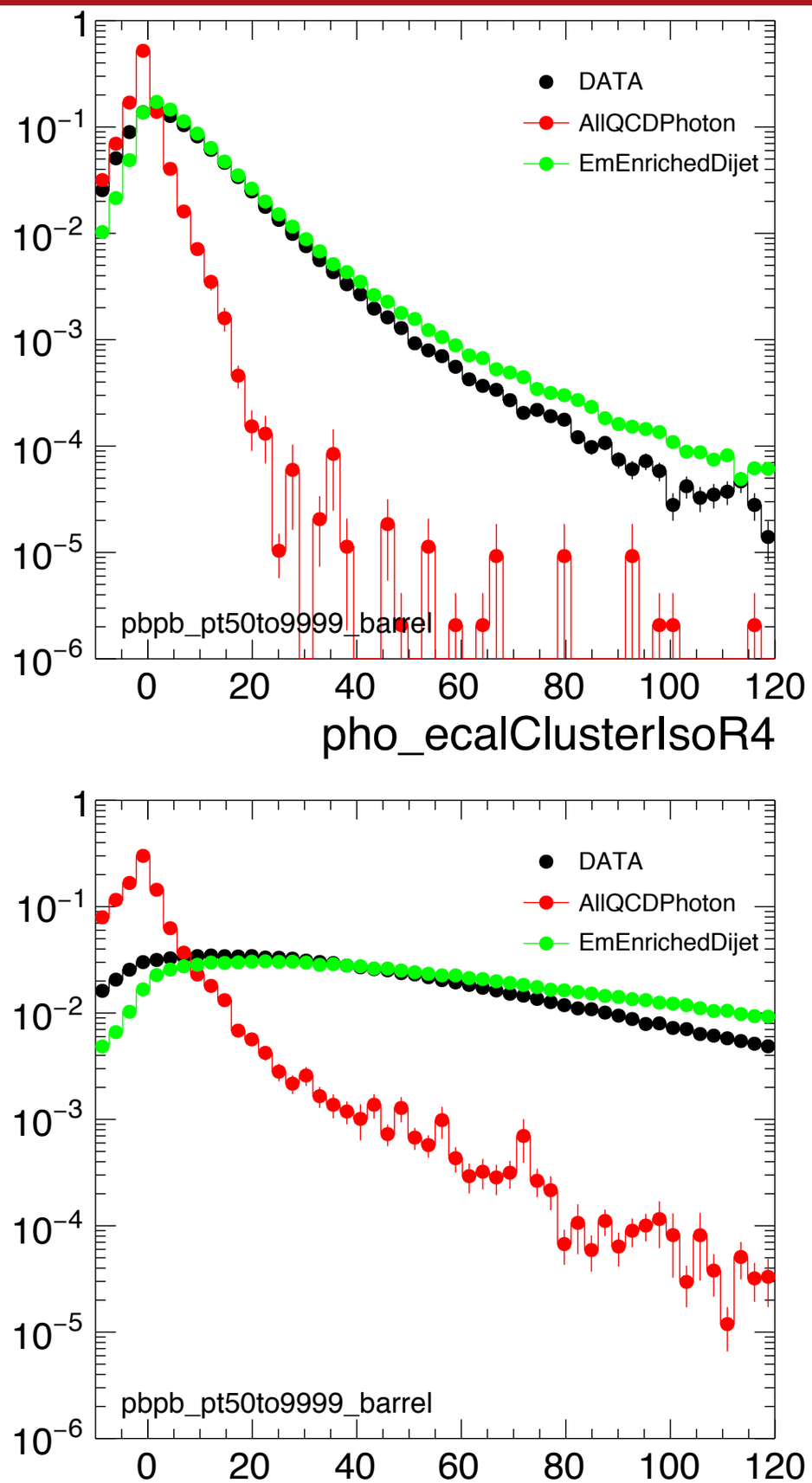
- **to-do : purity & efficiency correction for PbPb DATA**



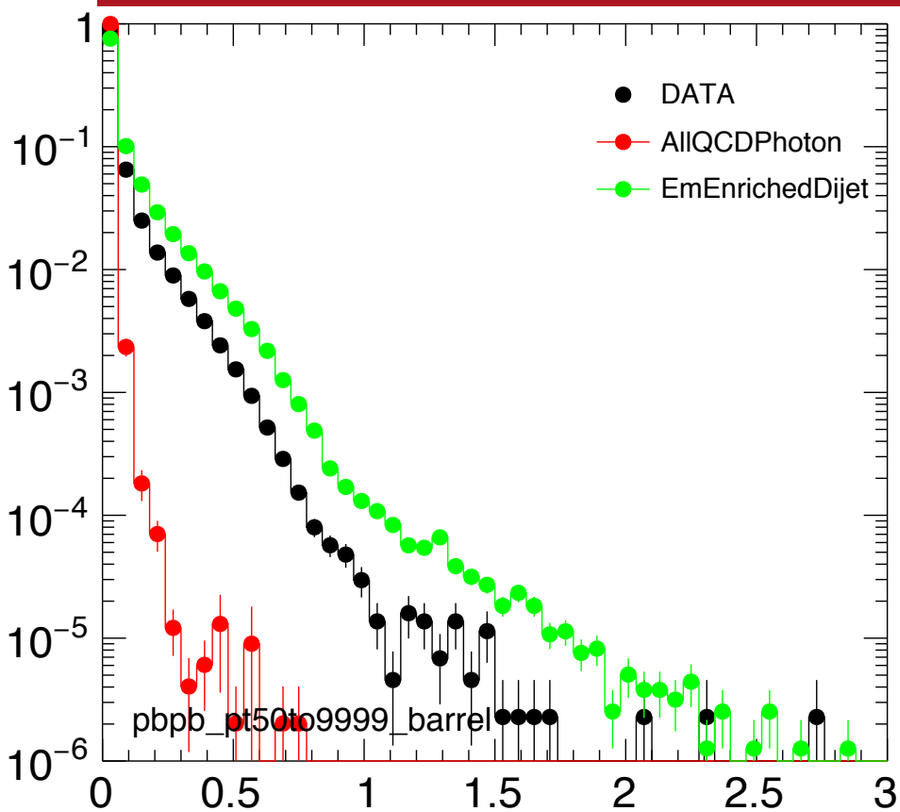
Dist. comparison DATA & MC

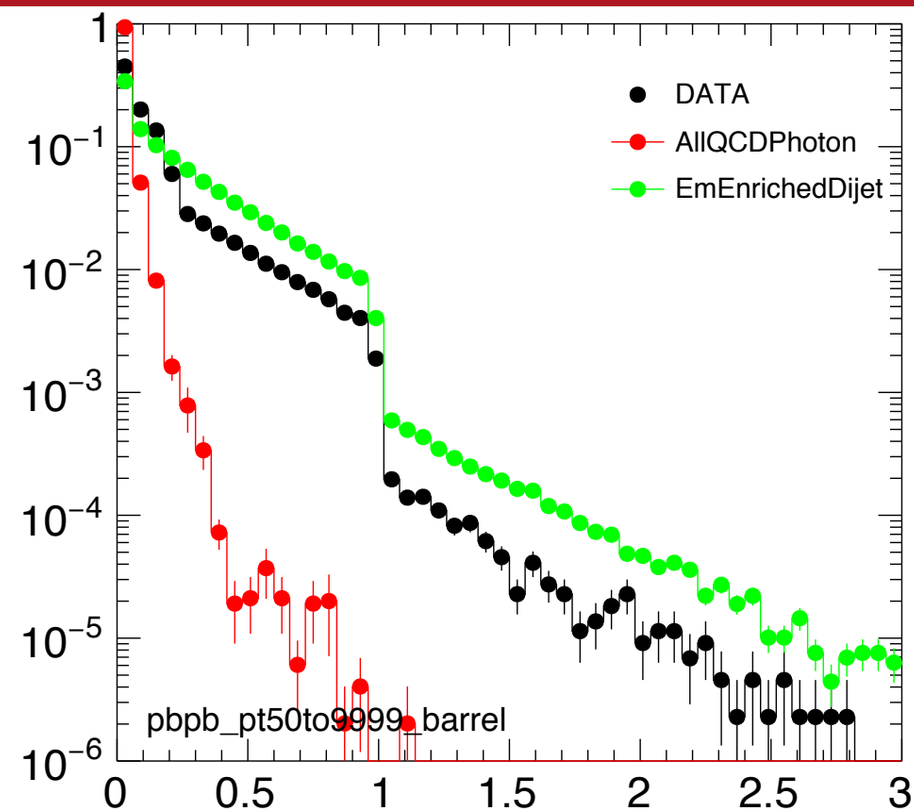
old Isolations R4



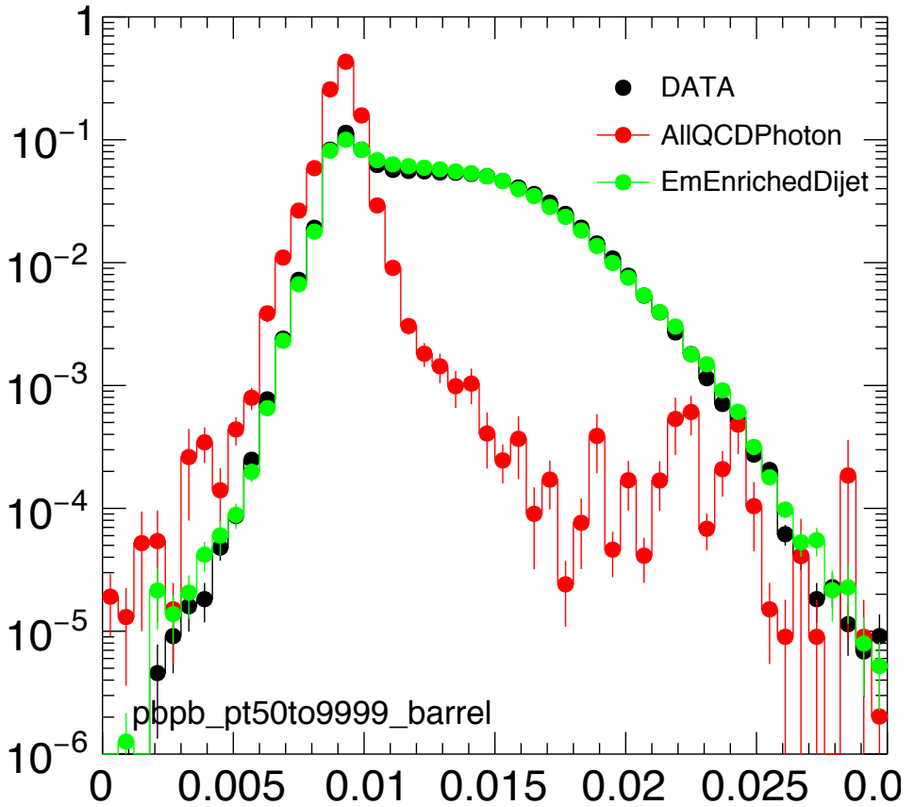


H/E, SigmaIEtaIEta, R9



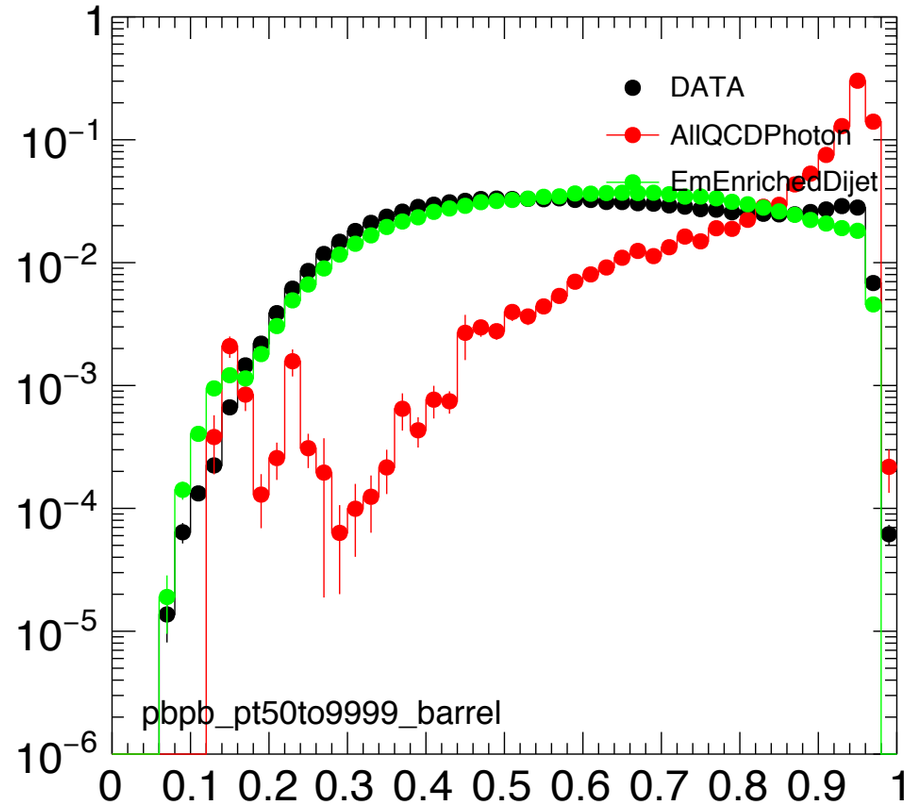


phoHadTowerOverEm



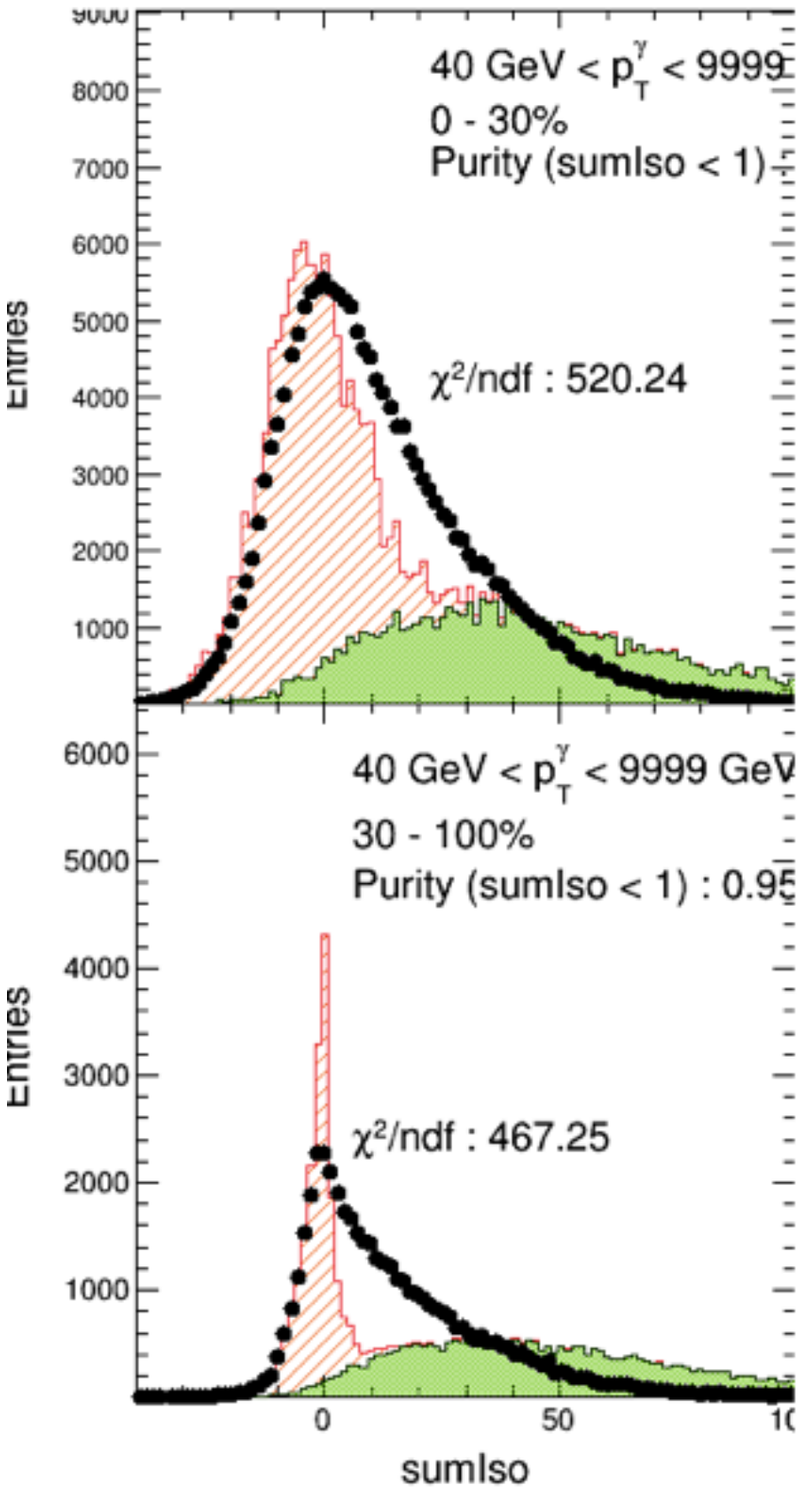
phoSigmaIEtaIEta_2012

phoHoverE

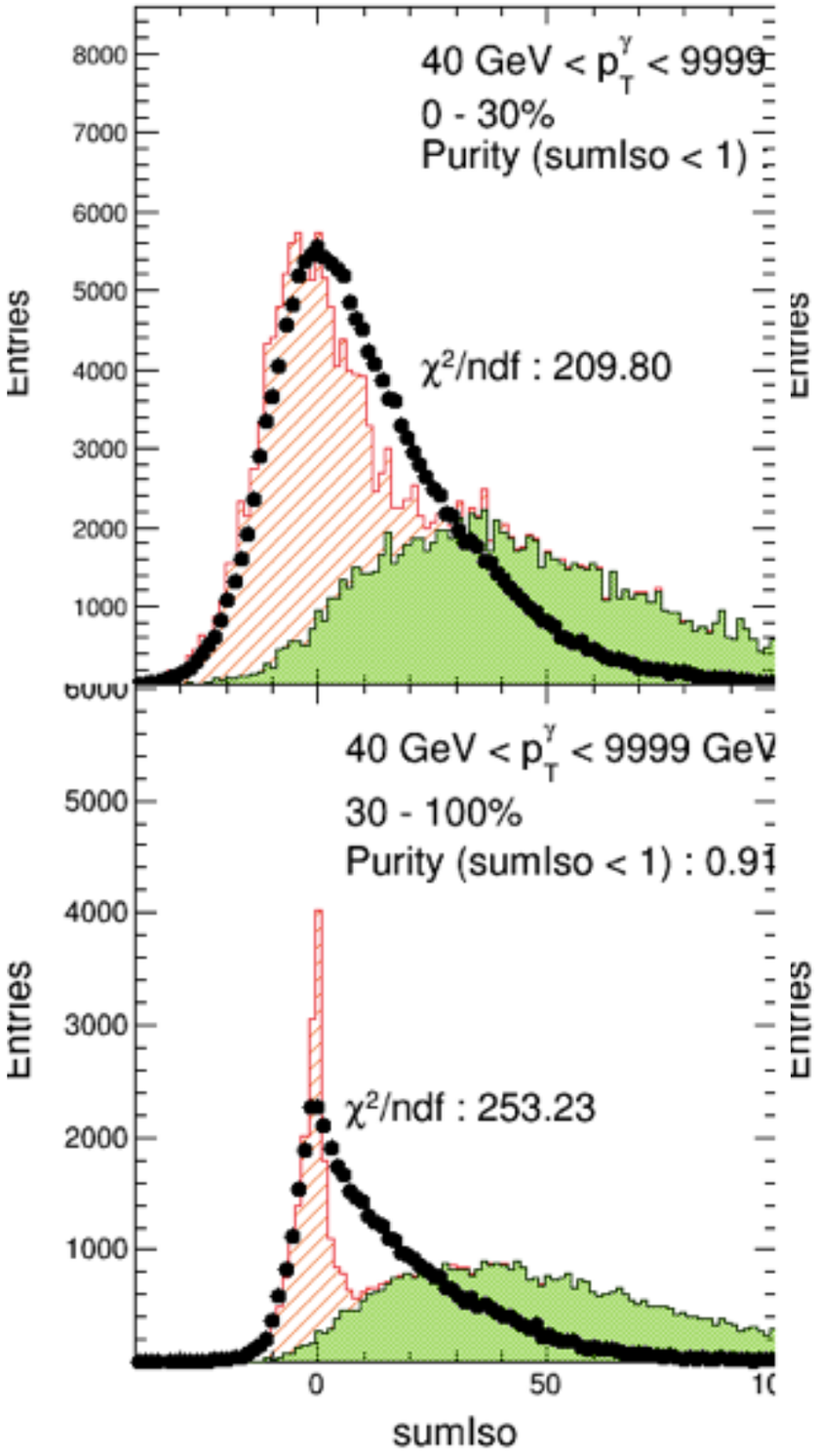


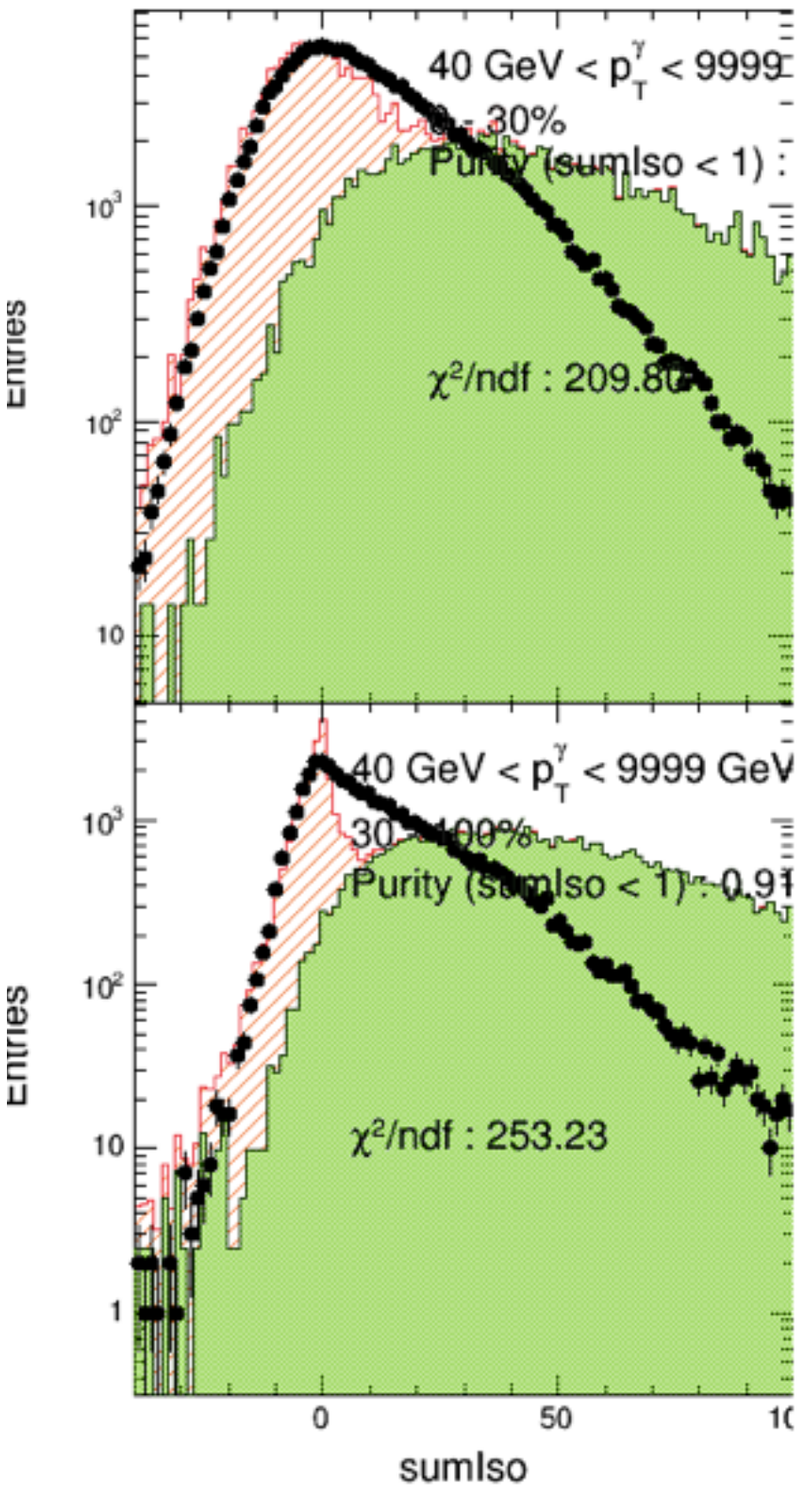
phoR9

BACK UP

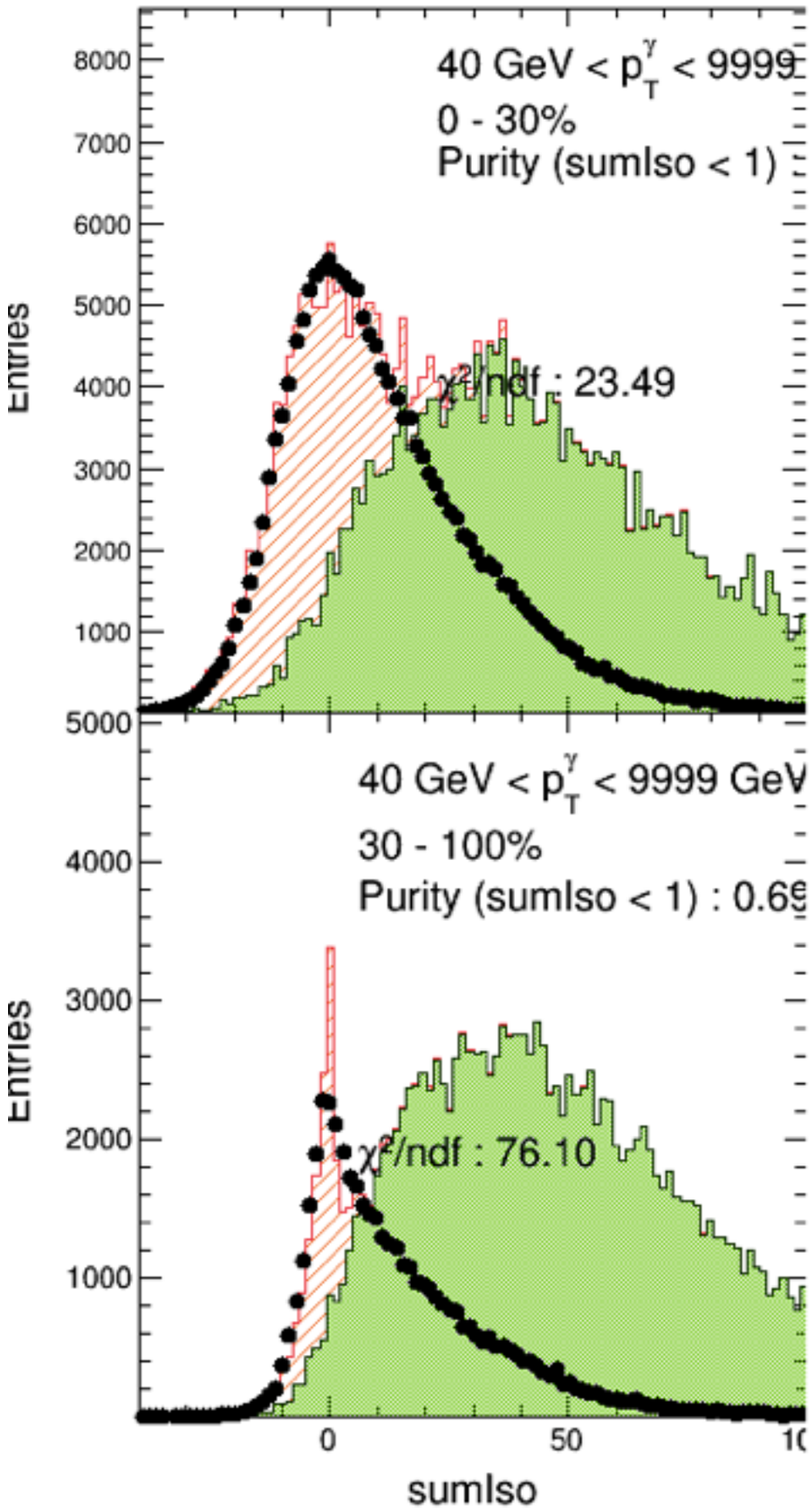


- **hoeCut && sampleIsolation && etaCut && spikeRejection && evtSel && hotspotCut**
- **fit range [-100,100]**
- **sideband cut**
  - (phoSigmaIEtaIEta_2012> 0.015) && phoHoverE<0.1

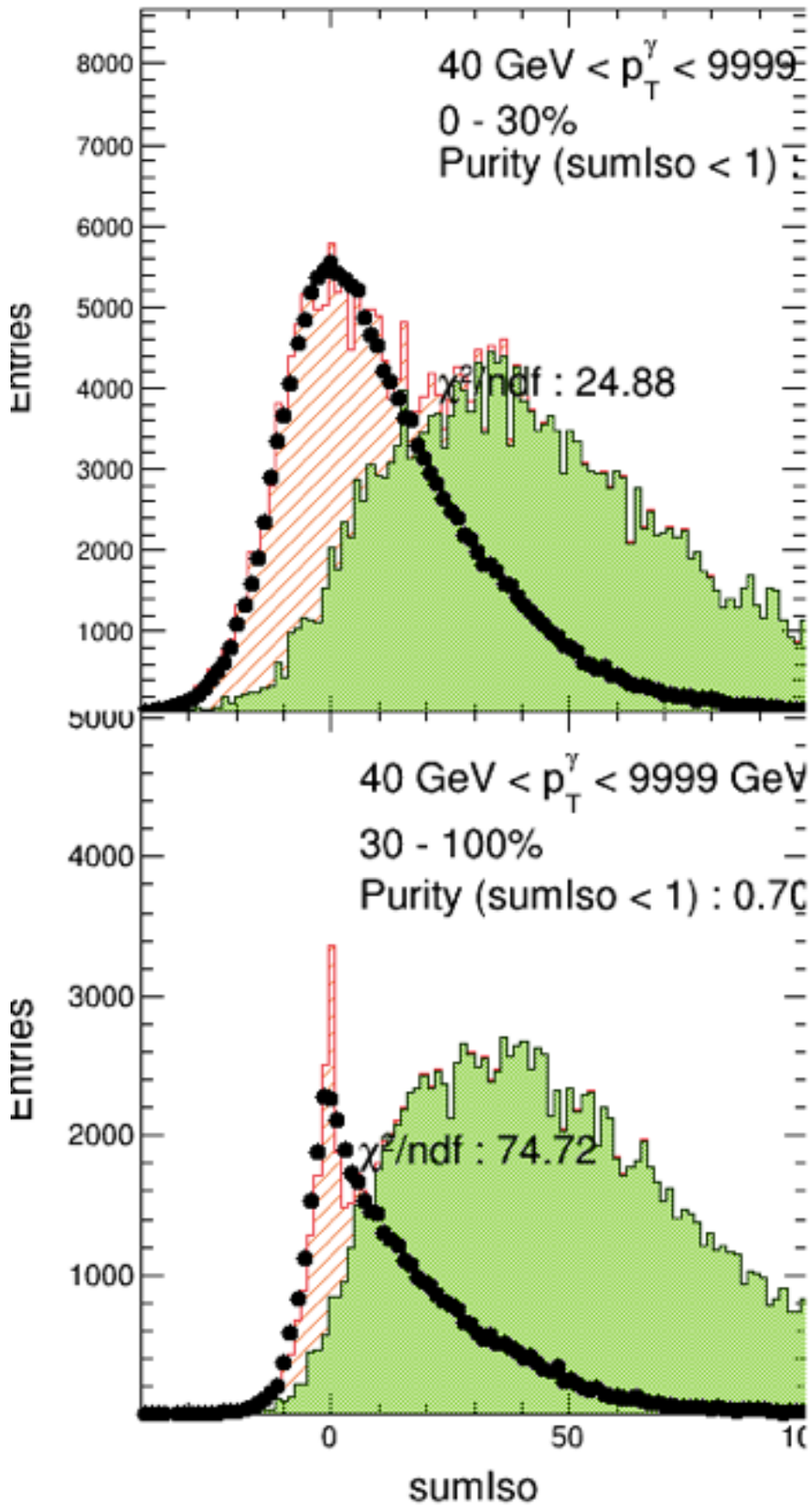




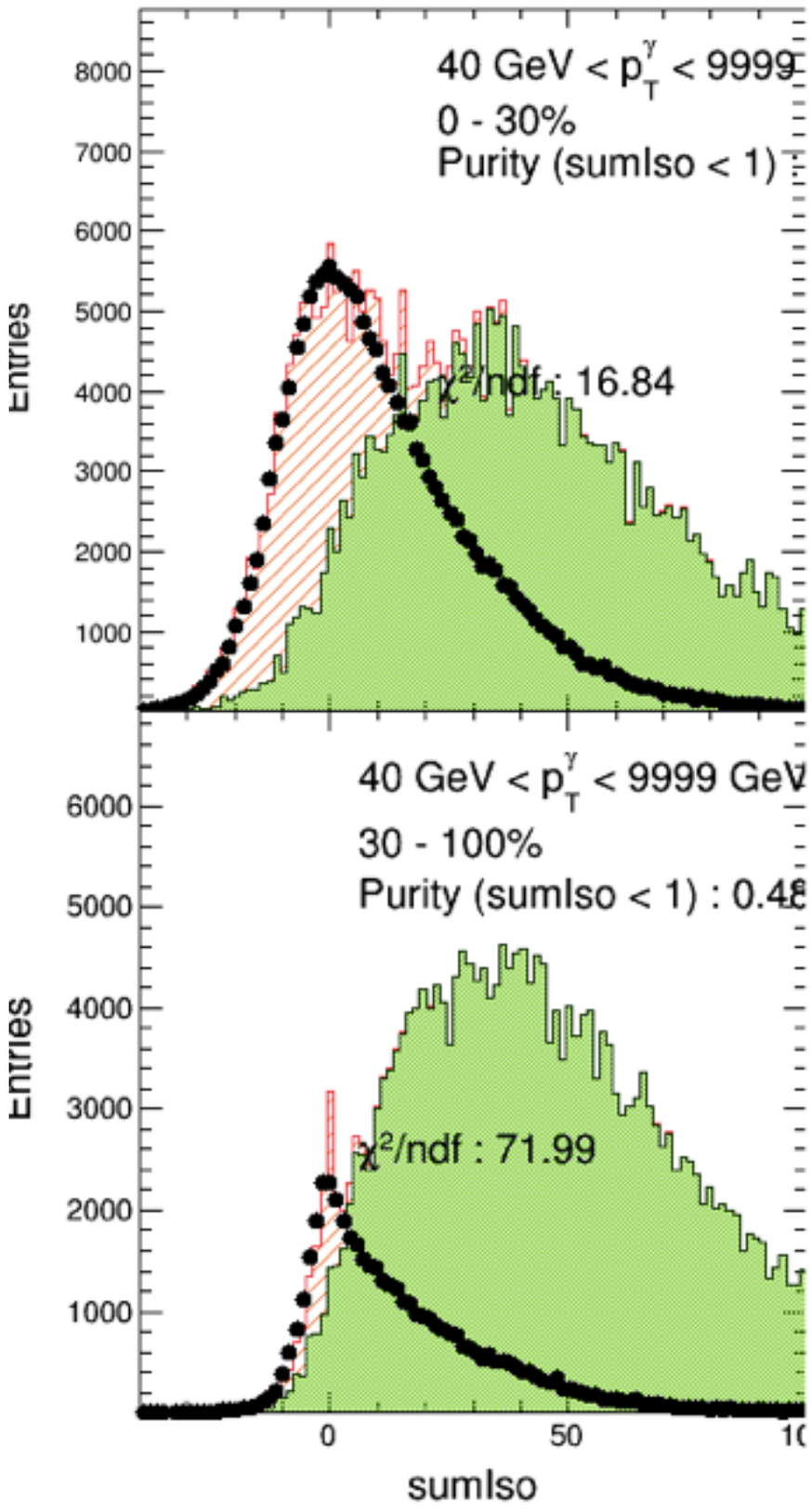
- **hoeCut && sampleIsolation && etaCut && spikeRejection && evtSel && hotspotCut**
- **fit range [-20,50]**
- **sideband cut**
  - (phoSigmaIEtaIEta_2012> 0.015) && phoHoverE<0.1



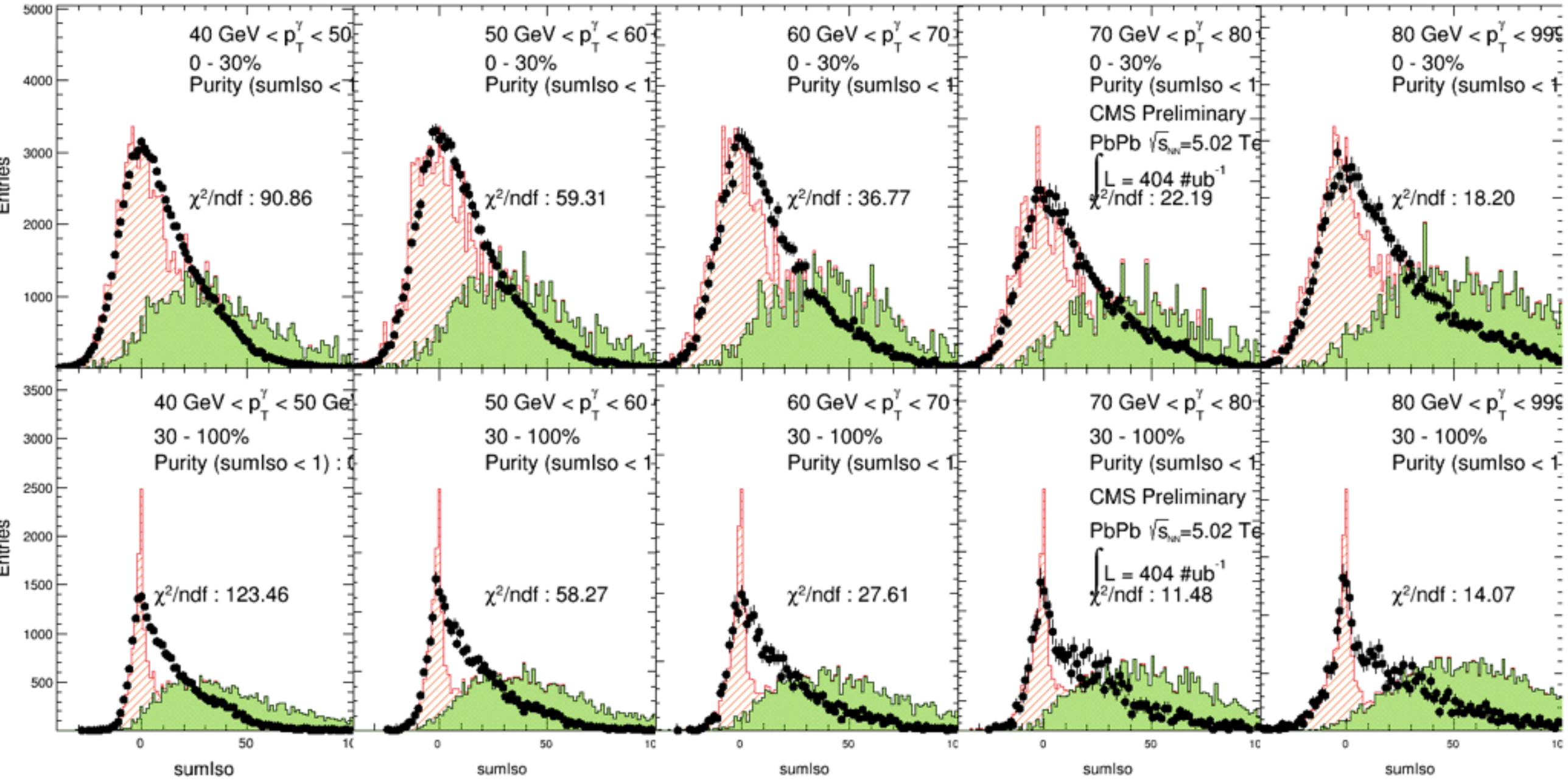
- **hoeCut && sampleIsolation && etaCut && spikeRejection && evtSel && hotspotCut**
- **fit range [-10,10]**
- **sideband cut**
  - (phoSigmaIEtaIEta_2012> 0.015) && phoHoverE<0.1



- **hoeCut && sampleIsolation && etaCut && spikeRejection && evtSel && hotspotCut**
- **fit range [-10,10]**
- **sideband cut**
  - (phoSigmaIEtaIEta_2012> 0.015 && phoSigmaIEtaIEta_2012<0.02) && phoHoverE<0.1



- **hoeCut && sampleIsolation && etaCut && spikeRejection && evtSel && hotspotCut**
- **fit range [-10,3]**
- **sideband cut**
  - (phoSigmaIEtaIEta_2012> 0.015 && phoSigmaIEtaIEta_2012<0.02) && phoHoverE<0.1



- **hoeCut && sampleIsolation && etaCut && spikeRejection && evtSel && hotspotCut**
- **fit range [-20,50]**
- **sideband cut**
  - (phoSigmaIEtaIEta_2012>0.015) && phoHoverE<0.1