Proposal to solving 2017 MiniAOD precision problem

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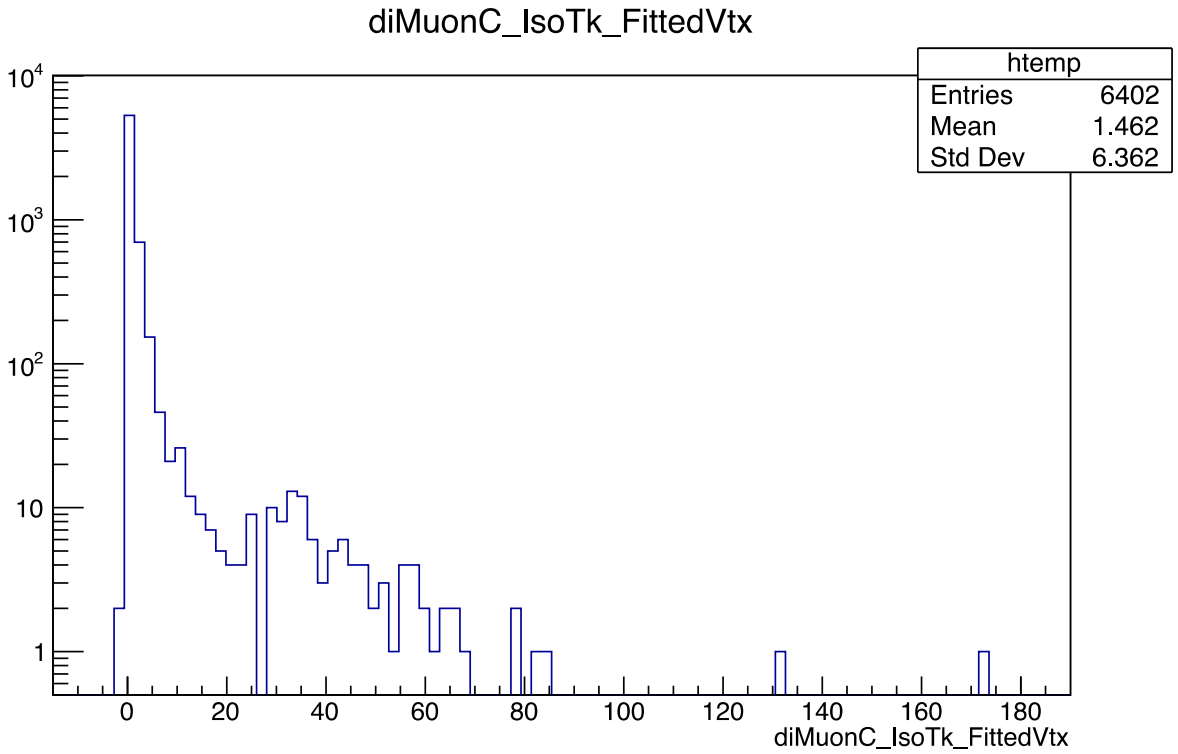
TAMU+RICE working meeting

Review of the problem

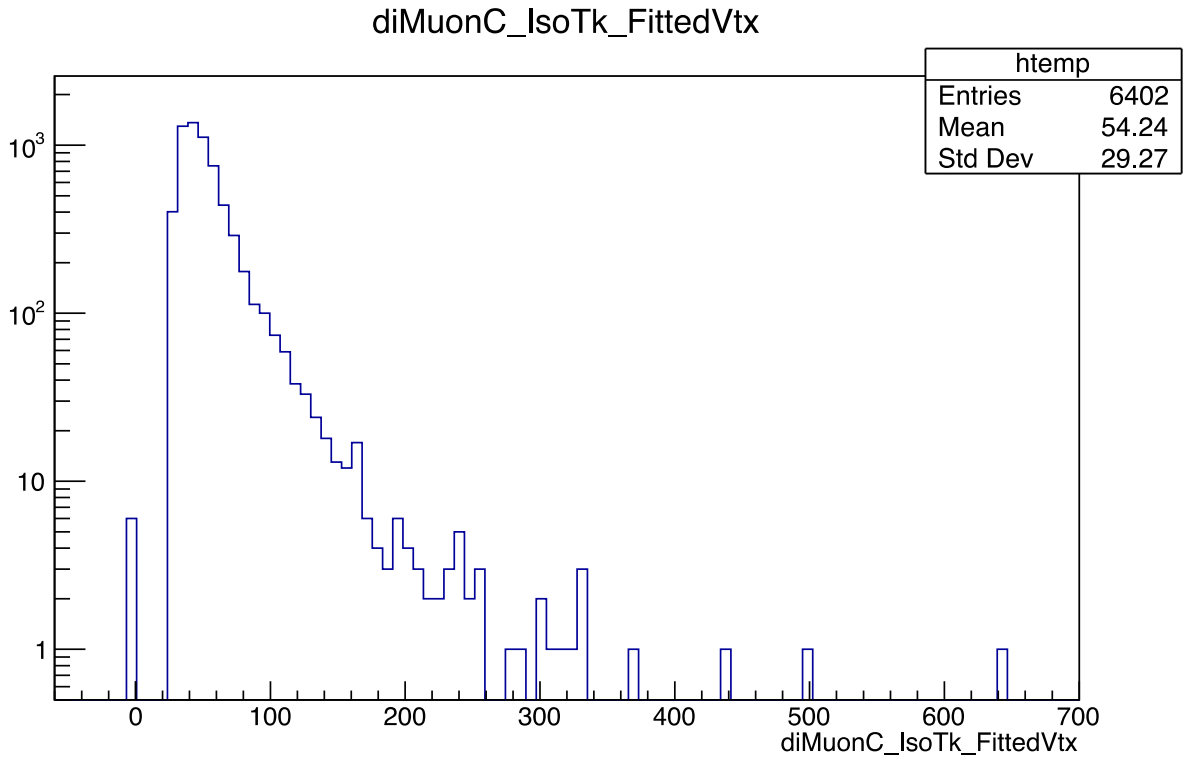
- Affect the dimuon isolation(whenever sameTrack is used)
  - Always include the dimuon itself in the isolation due to reduced muon track precision

```
bool tamu::helpers::sameTrack(const reco::Track *one, const reco::Track *two) {
  return (fabs(one->px() - two->px()) < 1e-10  &&
          fabs(one->py() - two->py()) < 1e-10  &&
          fabs(one->pz() - two->pz()) < 1e-10  &&
          fabs(one->vx() - two->vx()) < 1e-10  &&
          fabs(one->vy() - two->vy()) < 1e-10  &&
          fabs(one->vz() - two->vz()) < 1e-10);
}
```

Review of the problem



2017 AOD

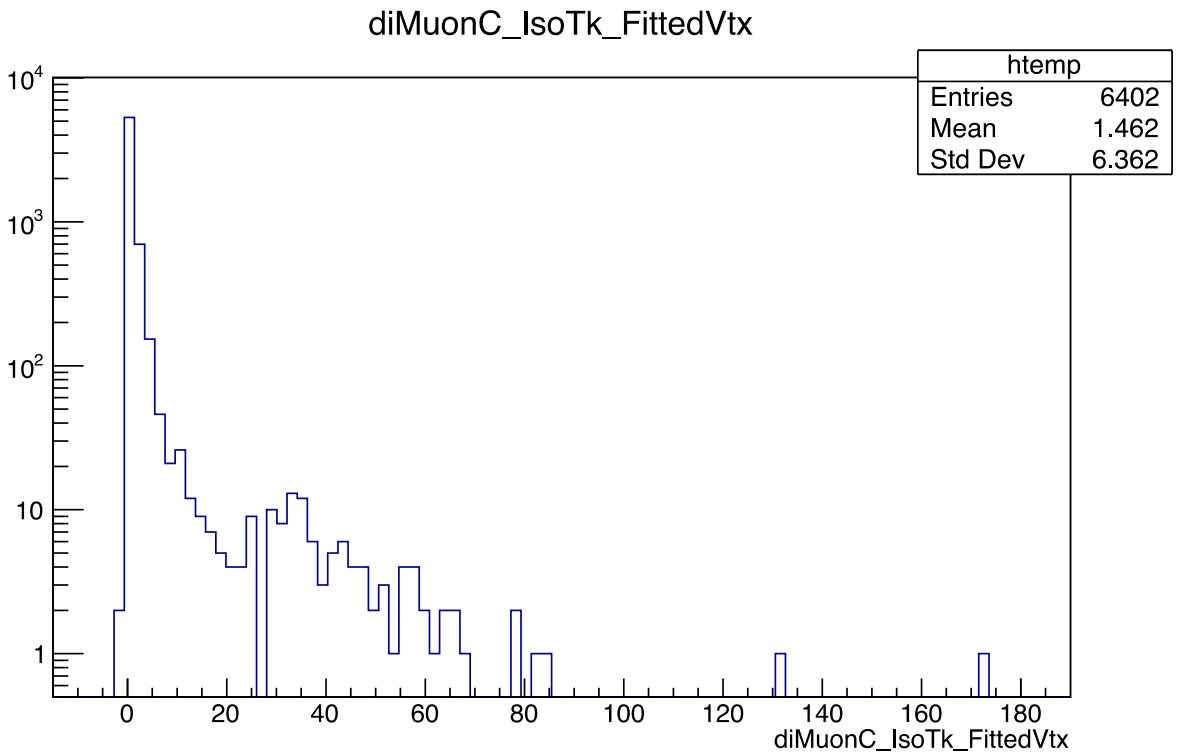


2017 MiniAOD

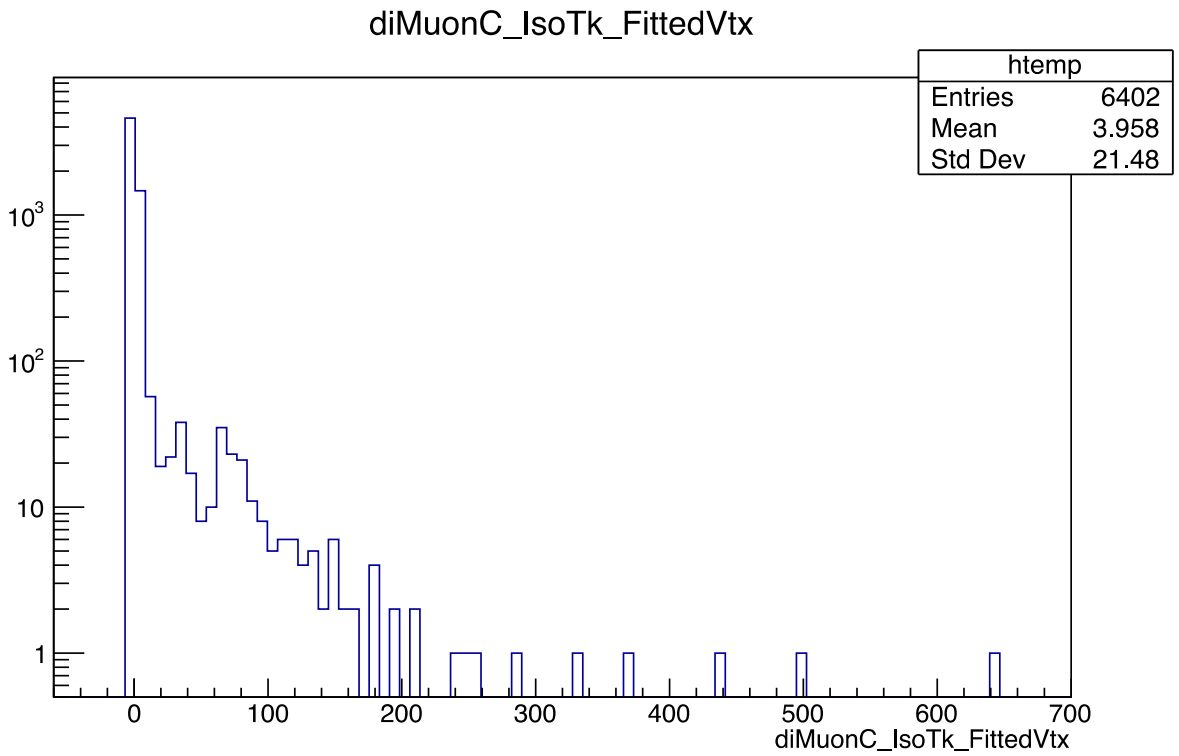
2017 MC sample 80k events

- Propose to relax the sametrack function difference: 1e-10
  - Starting in next slide, relax from 0.02 to 0.3
    - Compare one dimuon isolation plot
    - Cutflow table always remains same
  - I propose to change to 0.11 (slide 14)
    - Good for dimuon isolation
    - Same distribution at low isolation as AOD, similar distribution in general as AOD
    - Want isolation < 2 GeV in our analysis

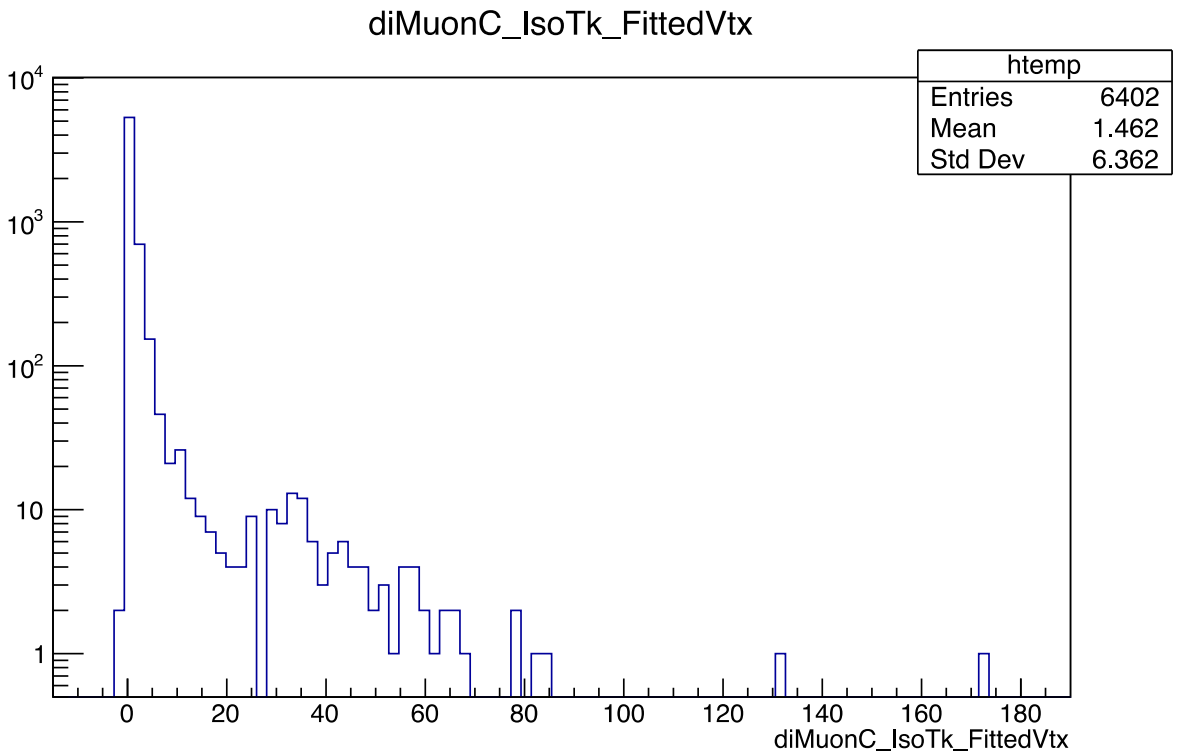
```
bool tamu::helpers::sameTrack(const reco::Track *one, const reco::Track *two) {
  return (fabs(one->px() - two->px()) < 1e-10  &&
          fabs(one->py() - two->py()) < 1e-10  &&
          fabs(one->pz() - two->pz()) < 1e-10  &&
          fabs(one->vx() - two->vx()) < 1e-10  &&
          fabs(one->vy() - two->vy()) < 1e-10  &&
          fabs(one->vz() - two->vz()) < 1e-10);
}
```



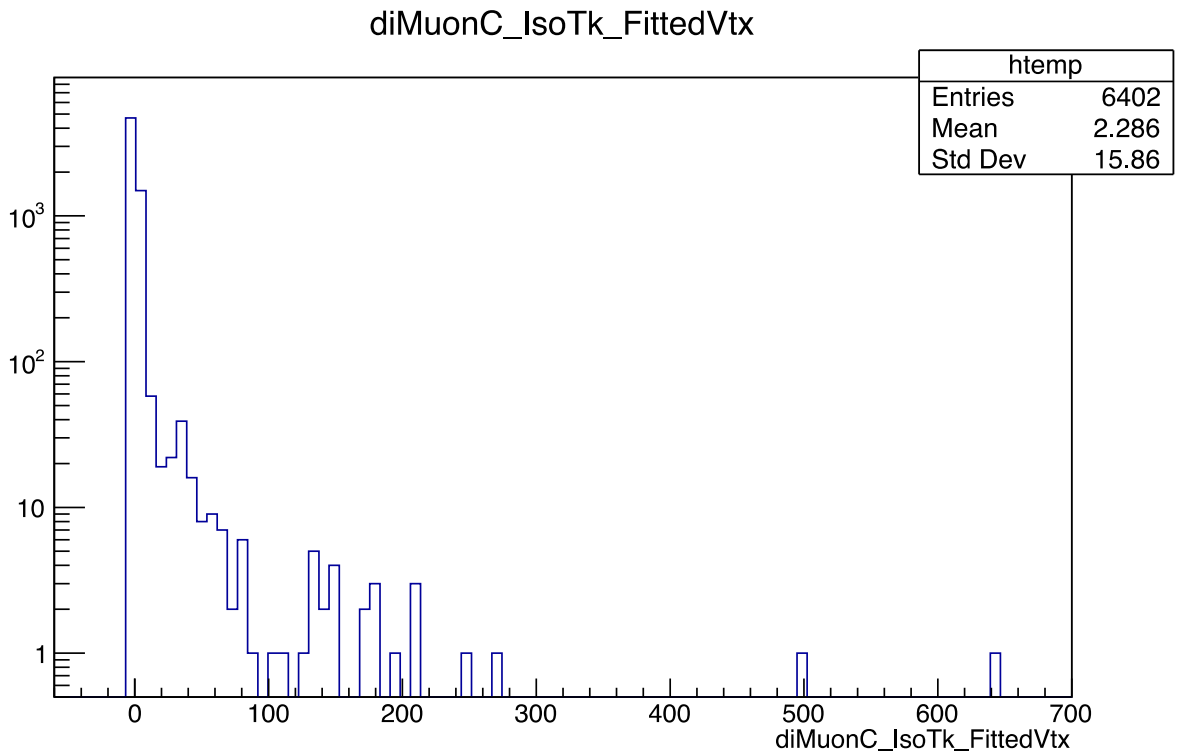
2017 AOD



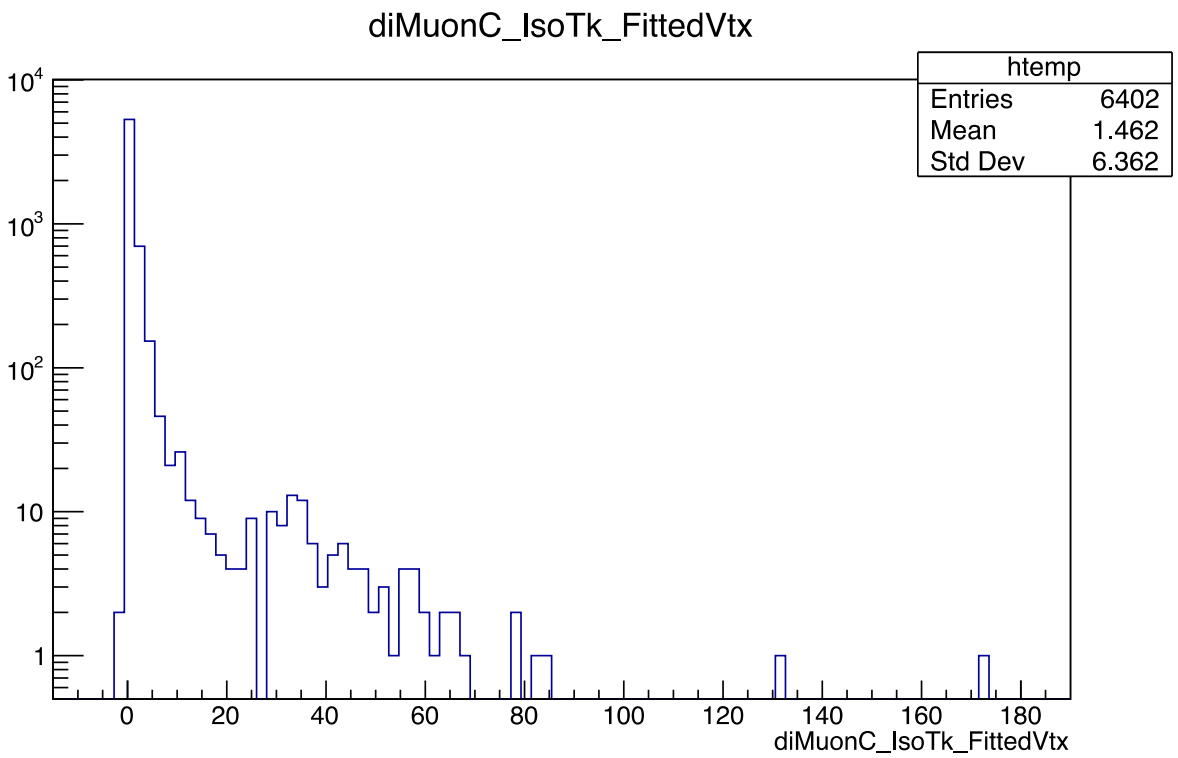
2017 MiniAOD 0p02



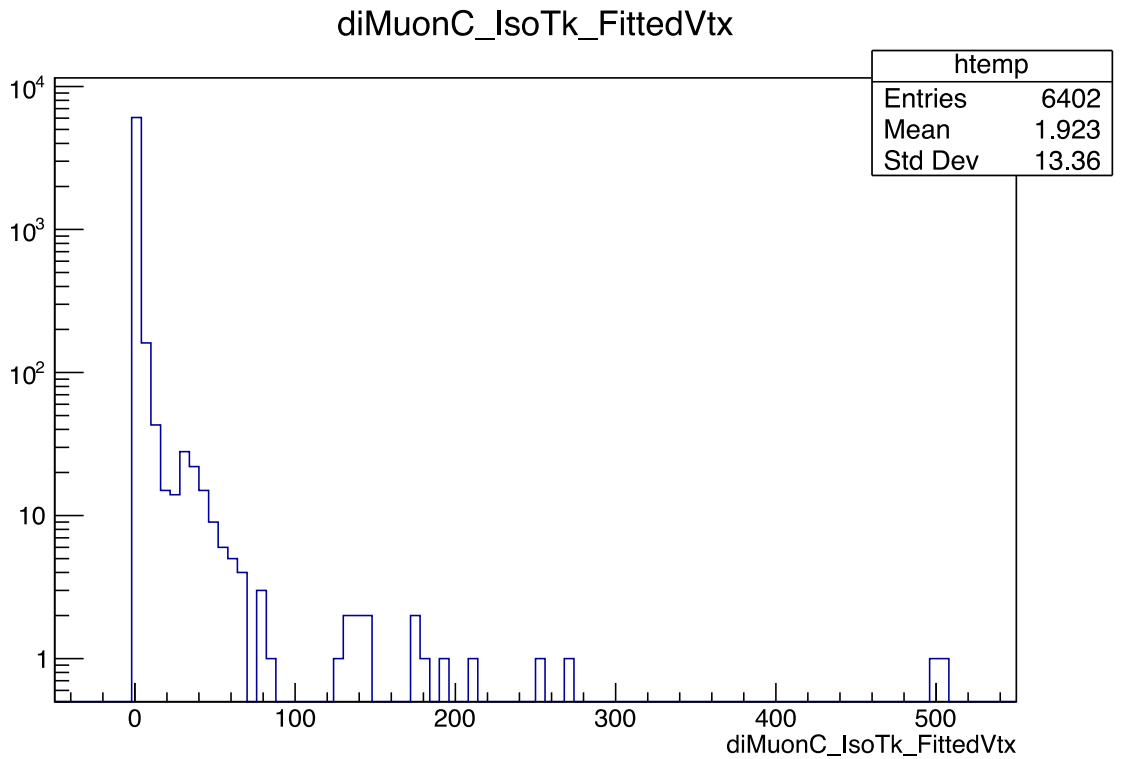
2017 AOD



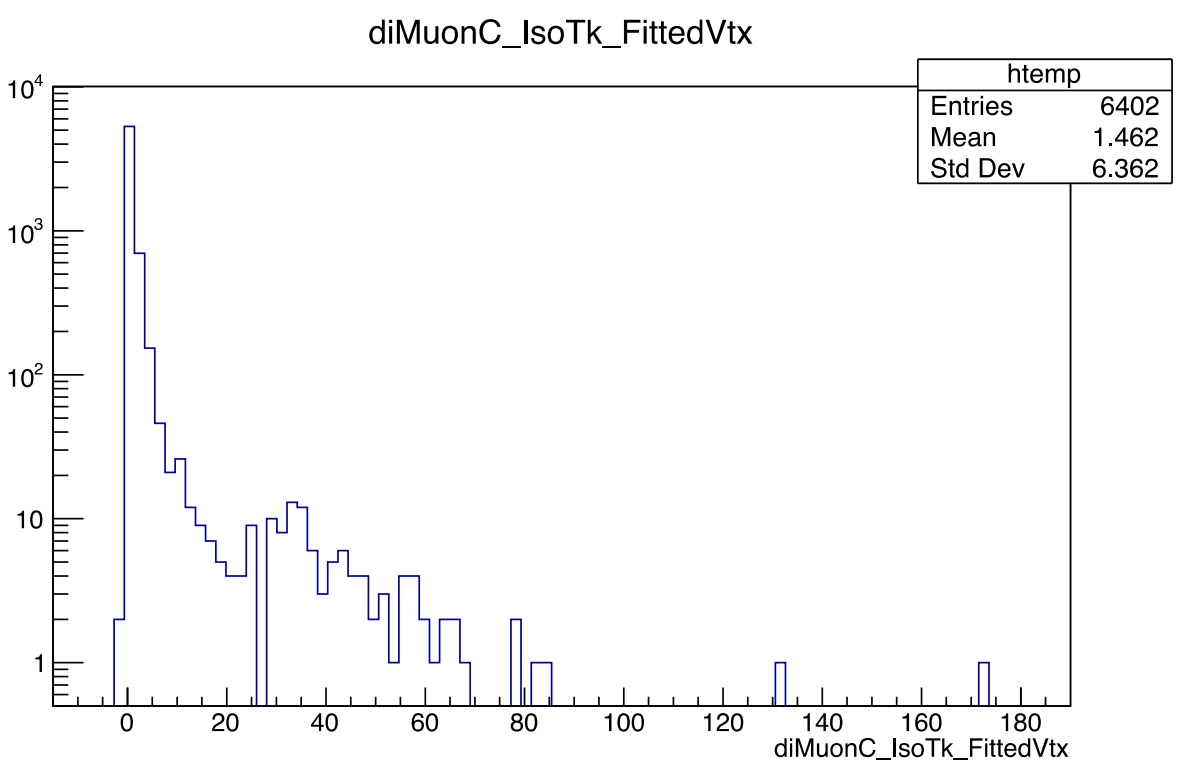
2017 MiniAOD 0p03



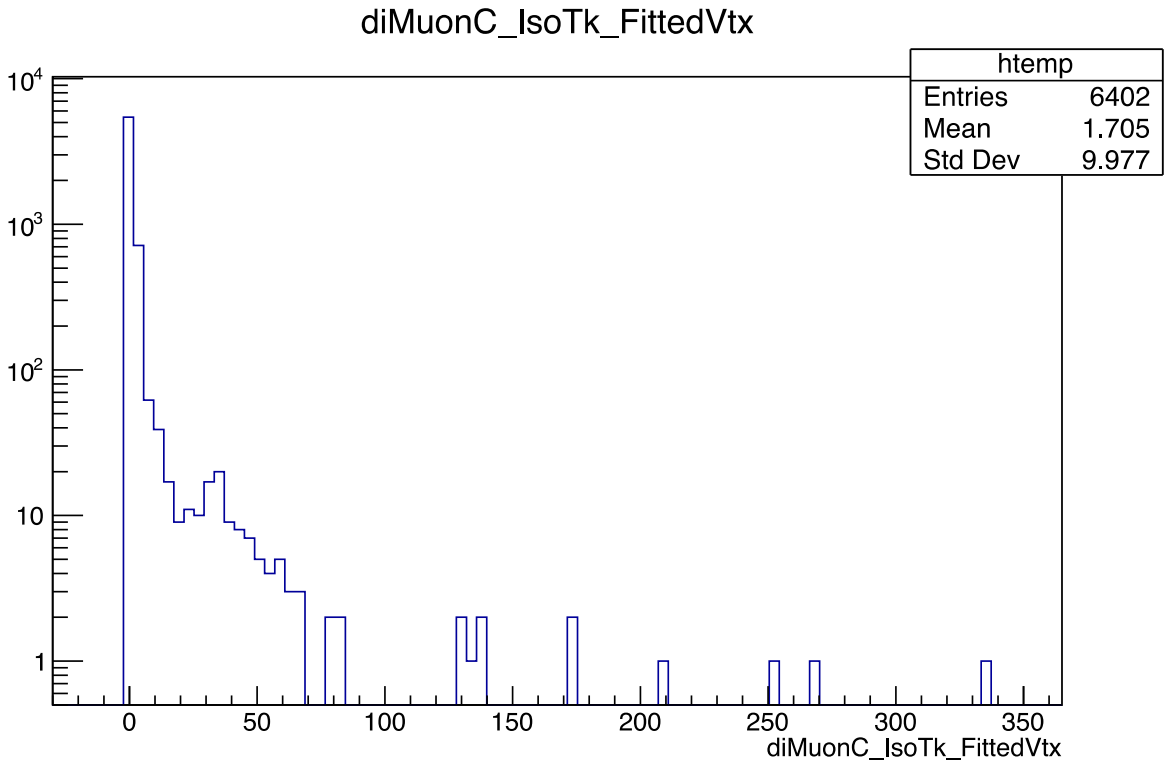
2017 AOD



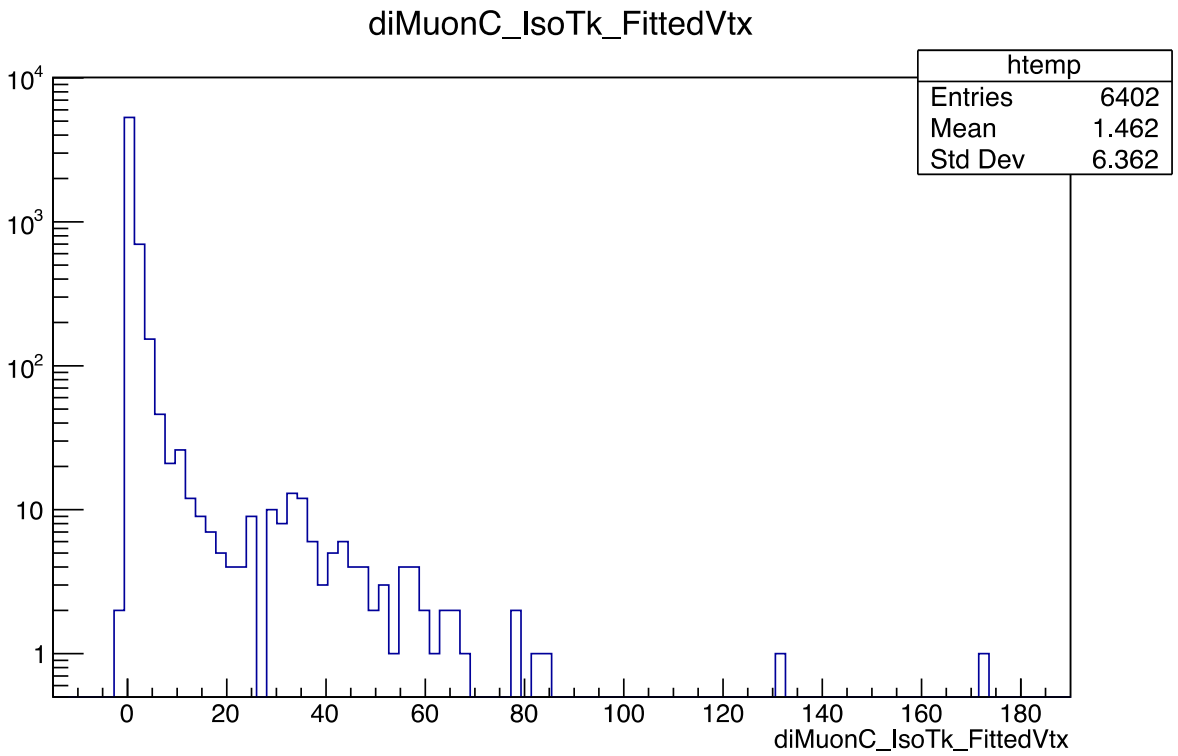
2017 MiniAOD 0p04



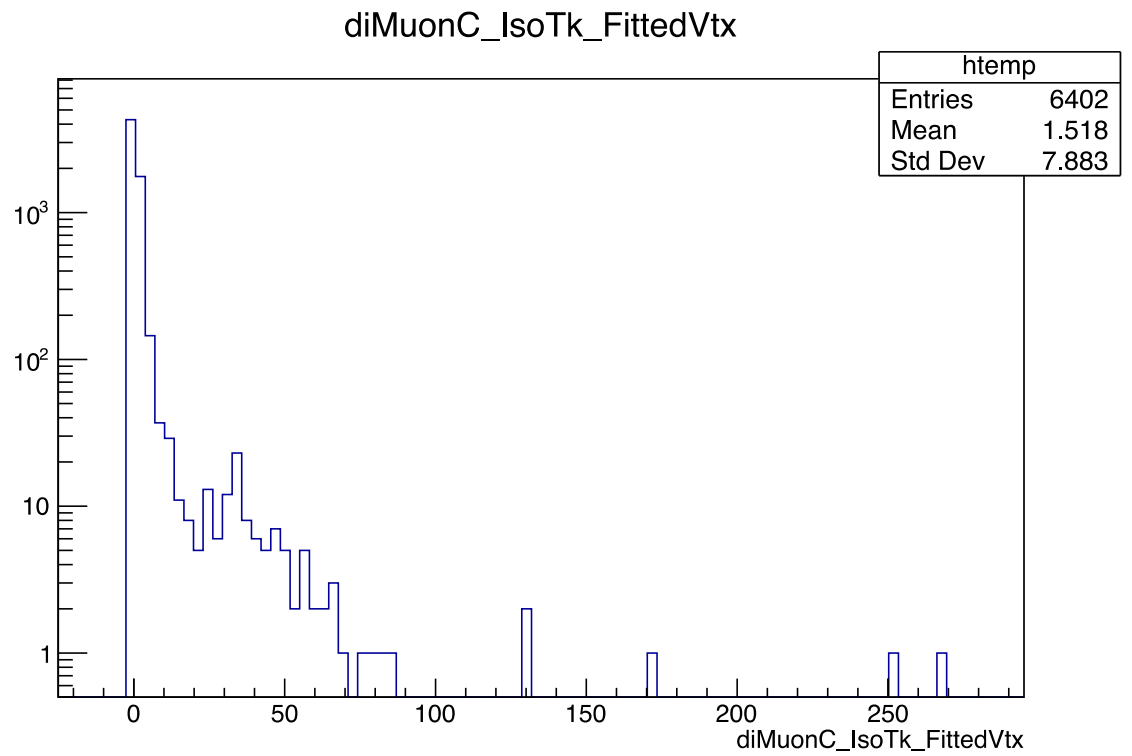
2017 AOD



2017 MiniAOD 0p05



2017 AOD



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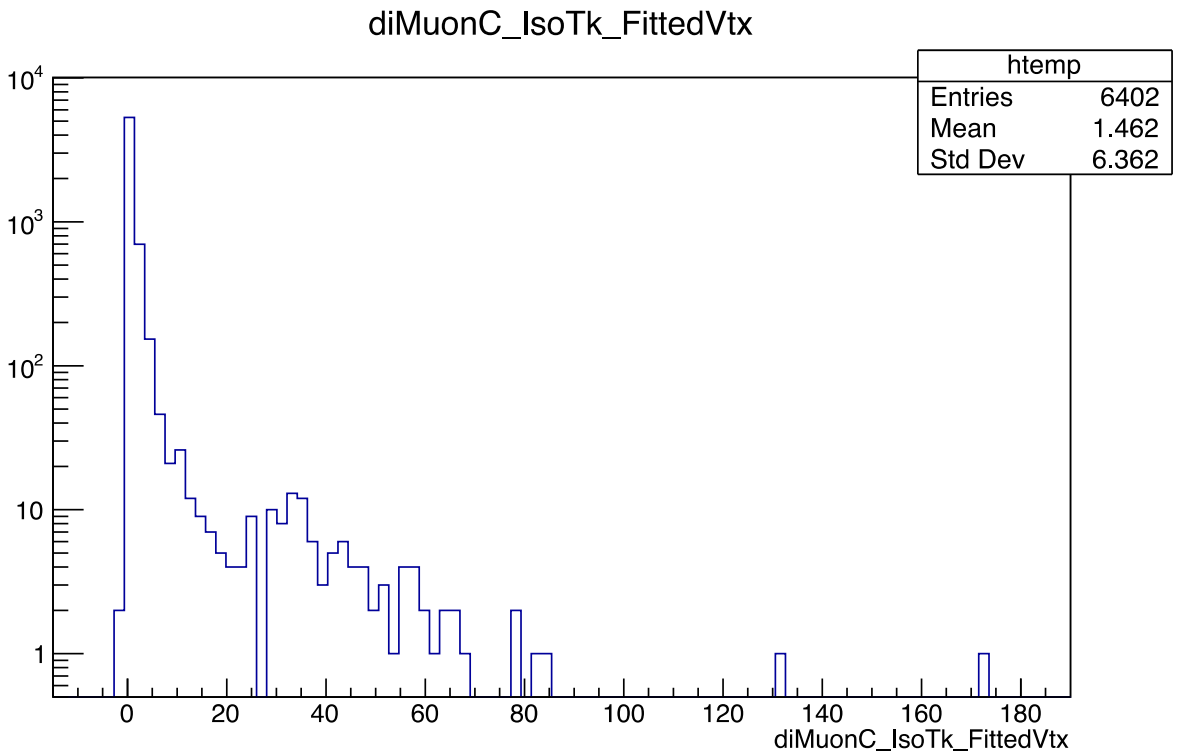
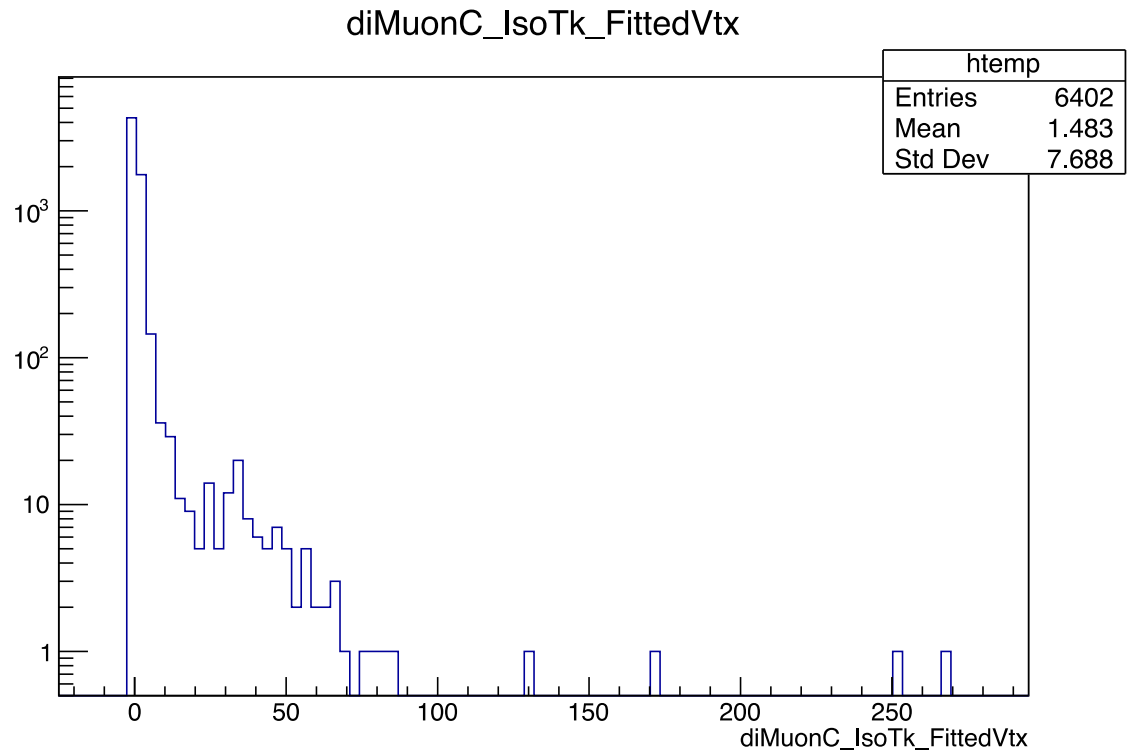
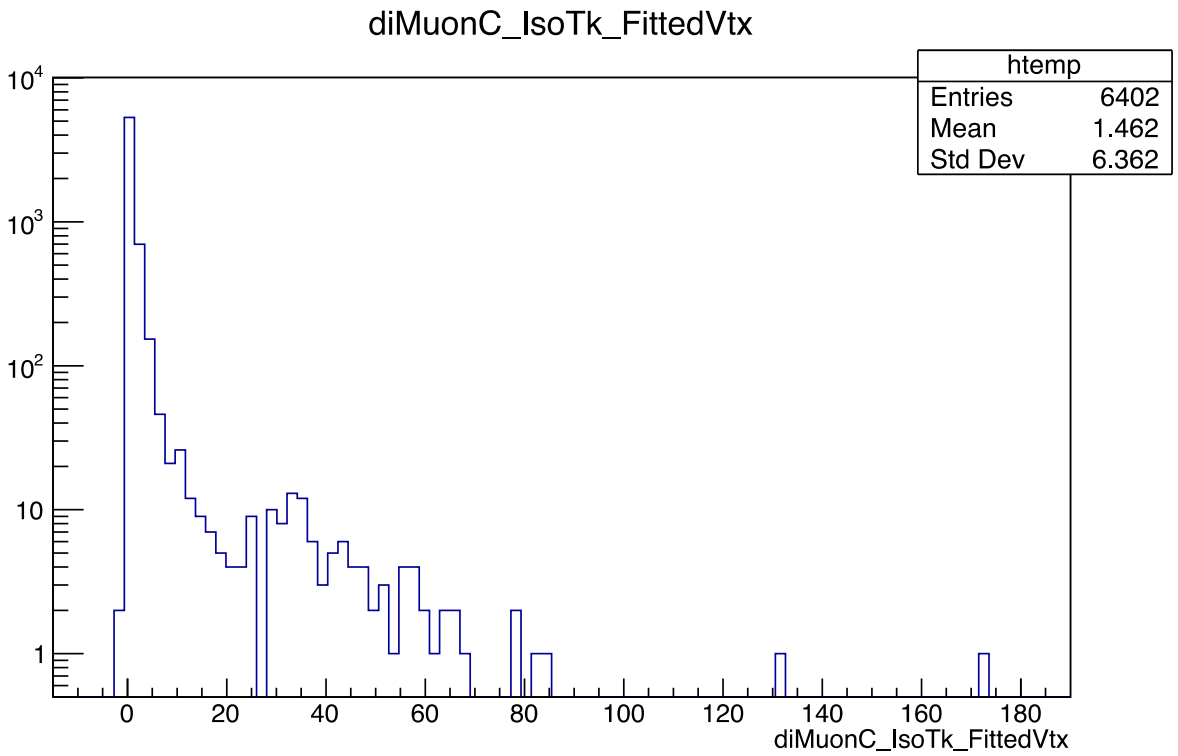


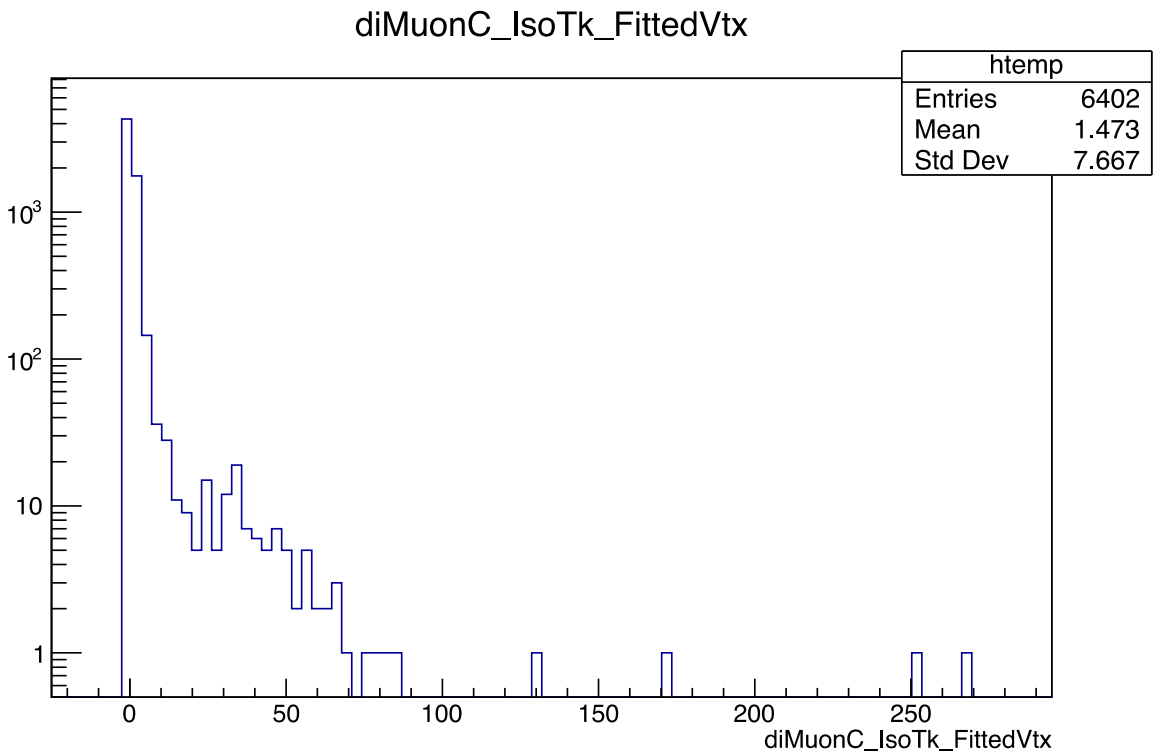
2017 AOD



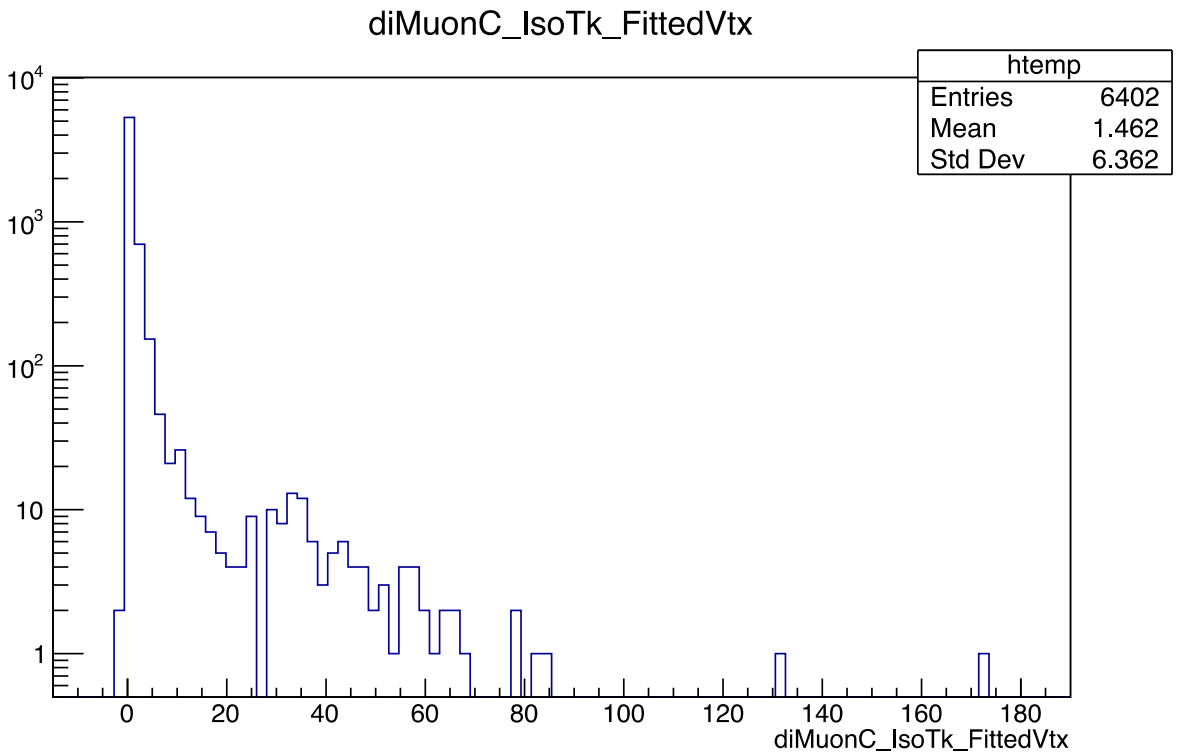
2017 MiniAOD 0p07



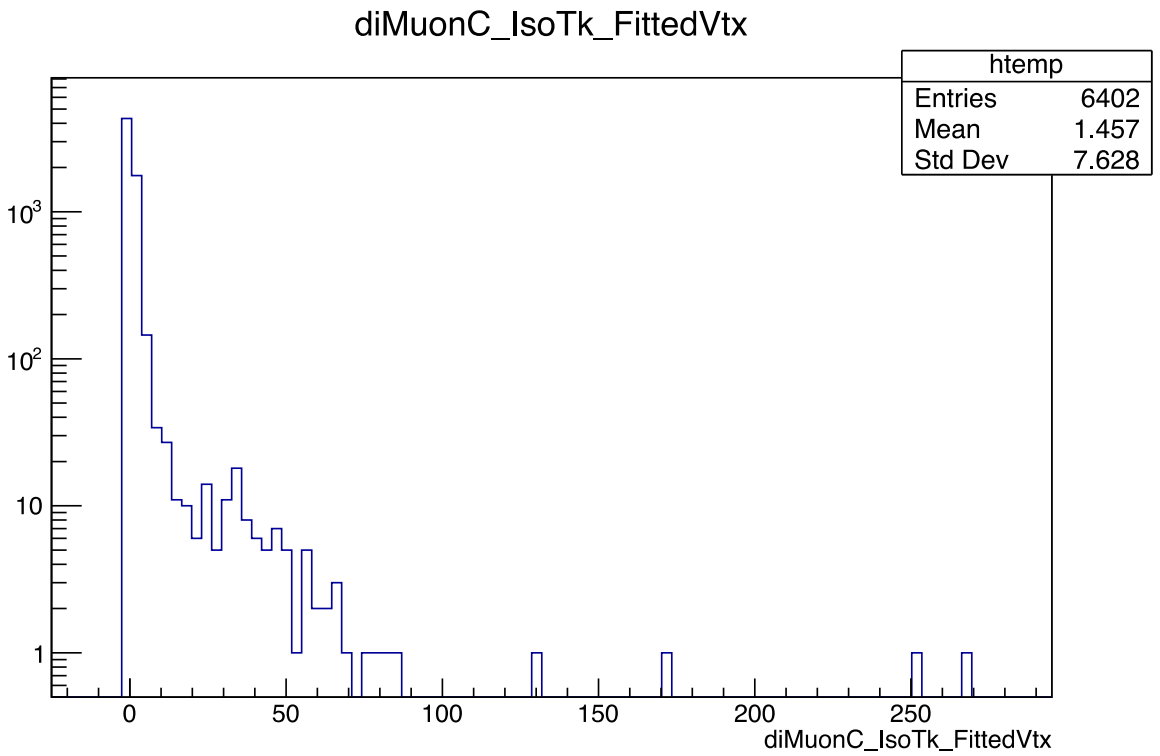
2017 AOD



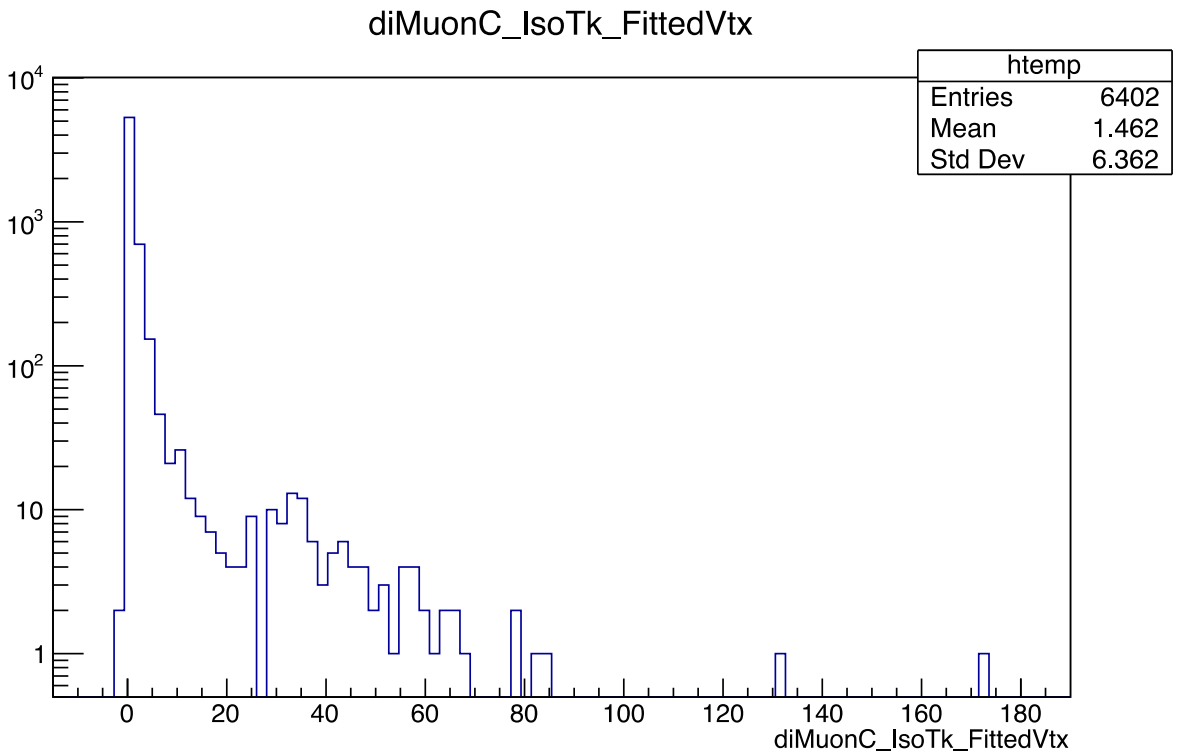
2017 MiniAOD 0p08



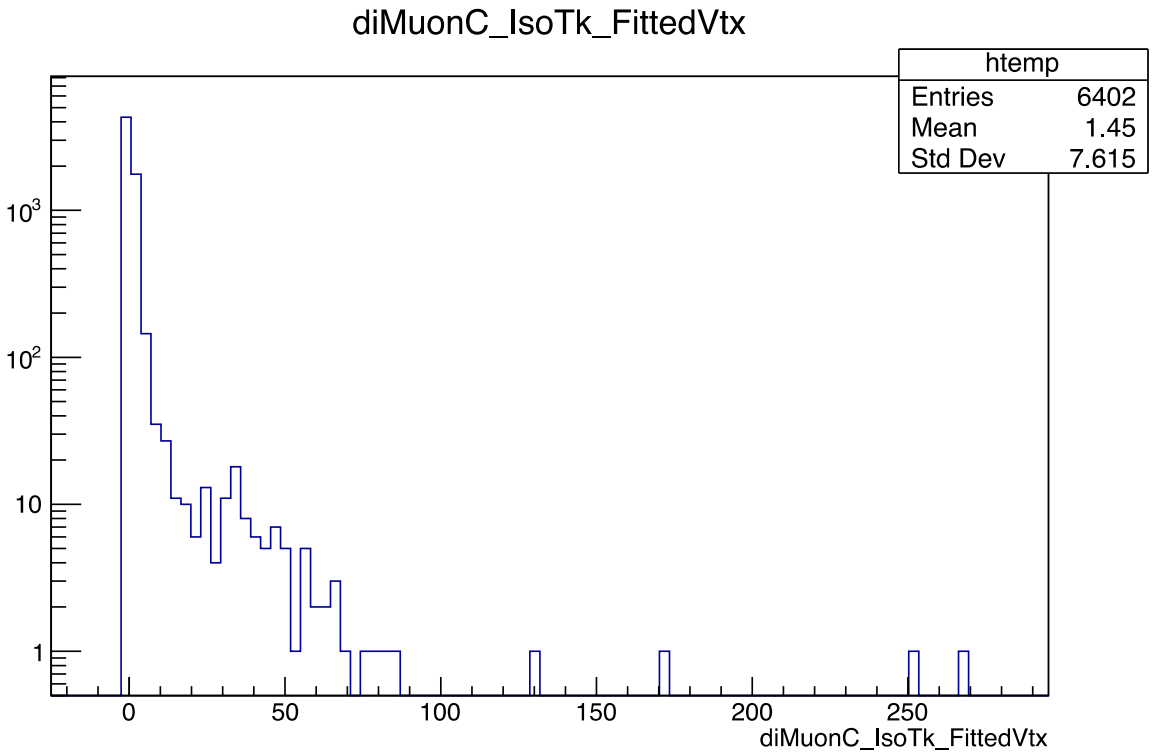
2017 AOD



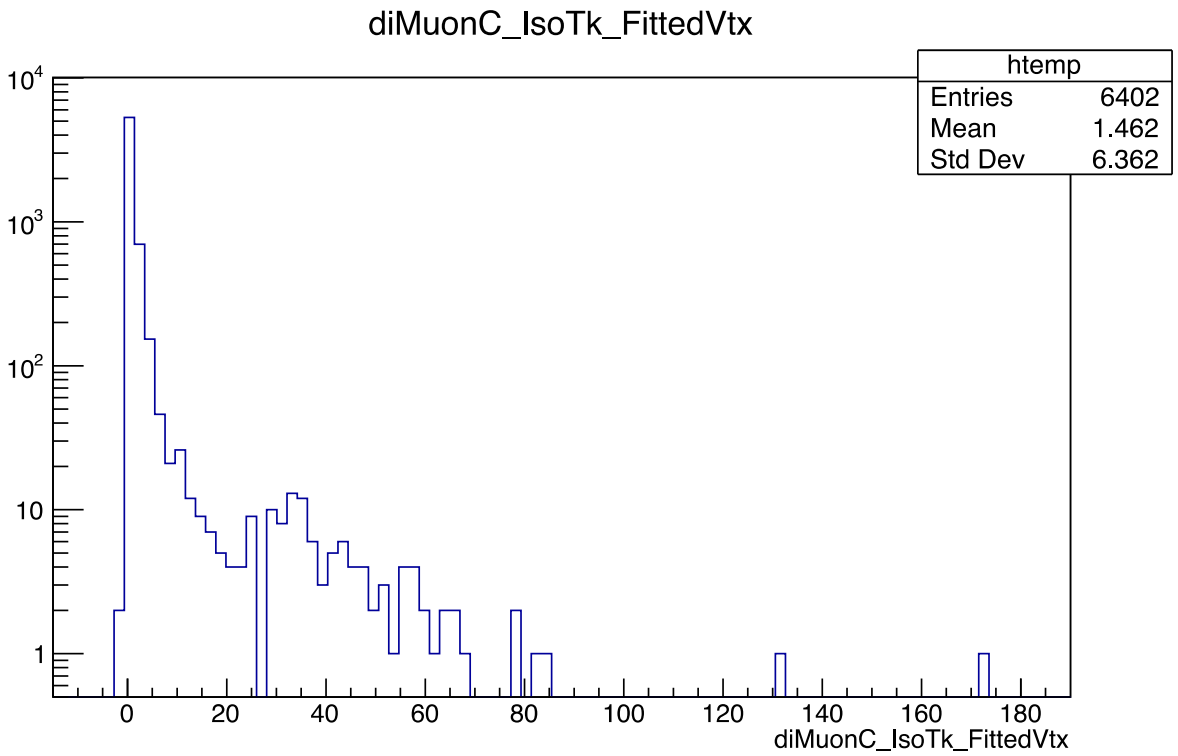
2017 MiniAOD 0p09



2017 AOD



2017 MiniAOD 0p1



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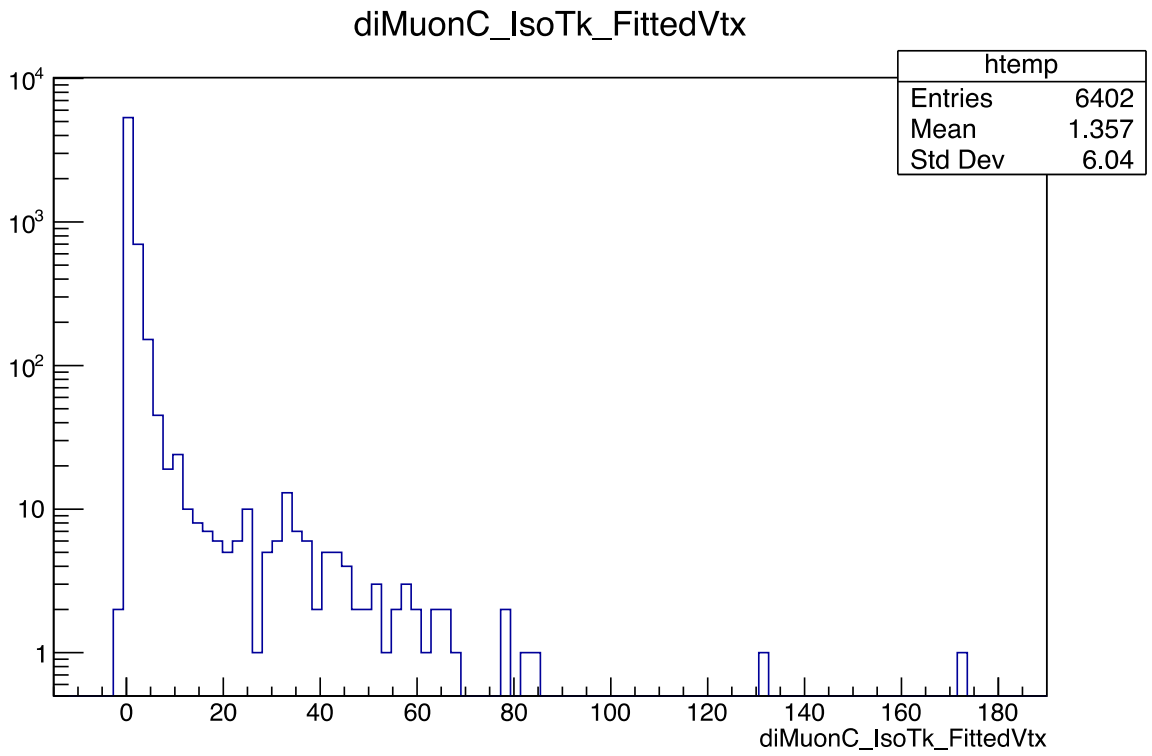
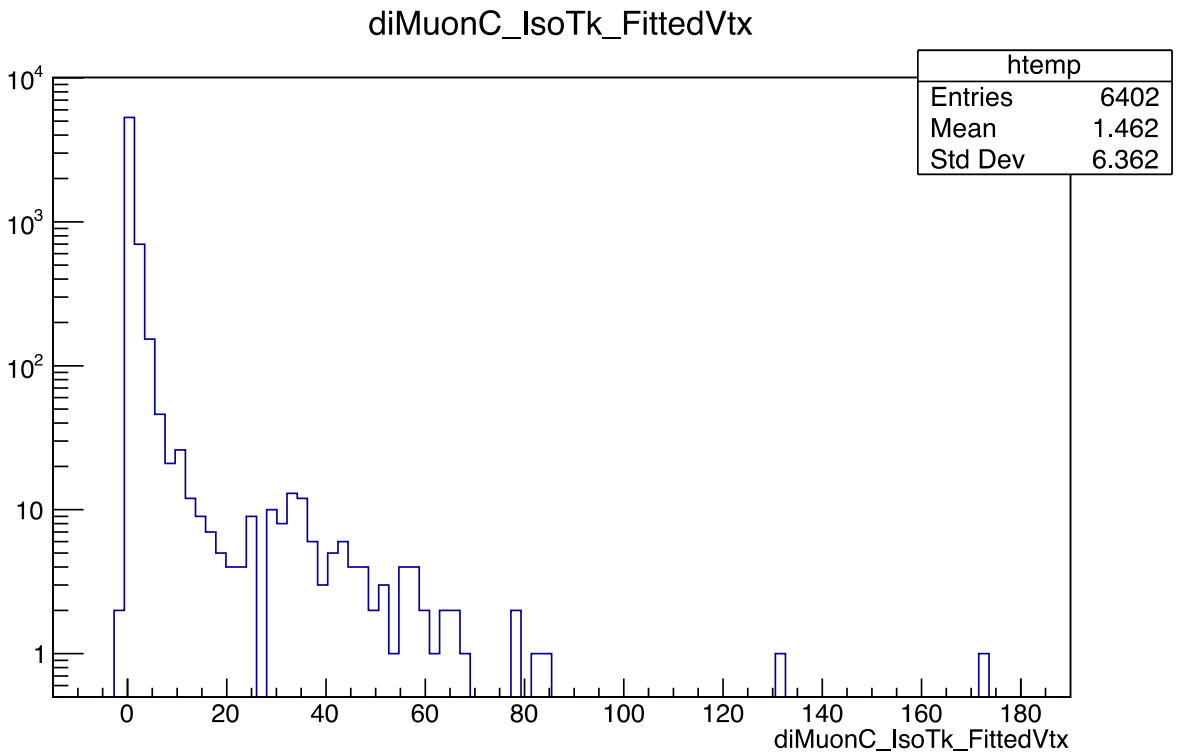
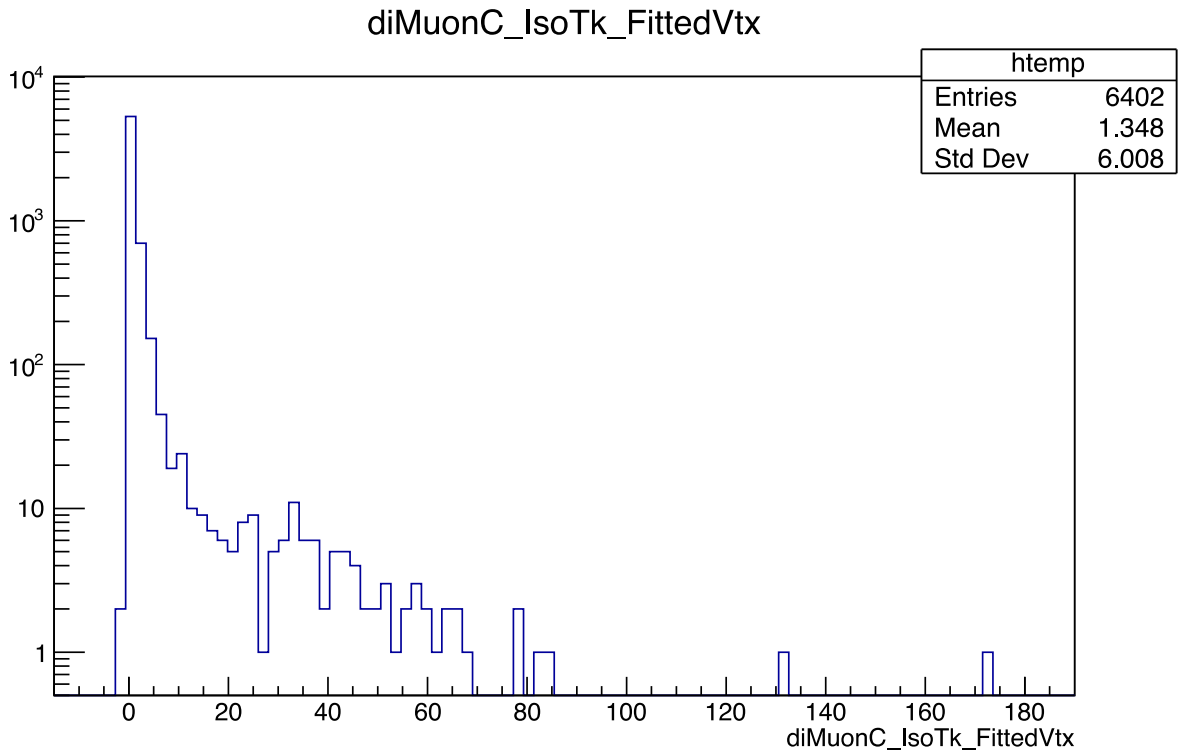


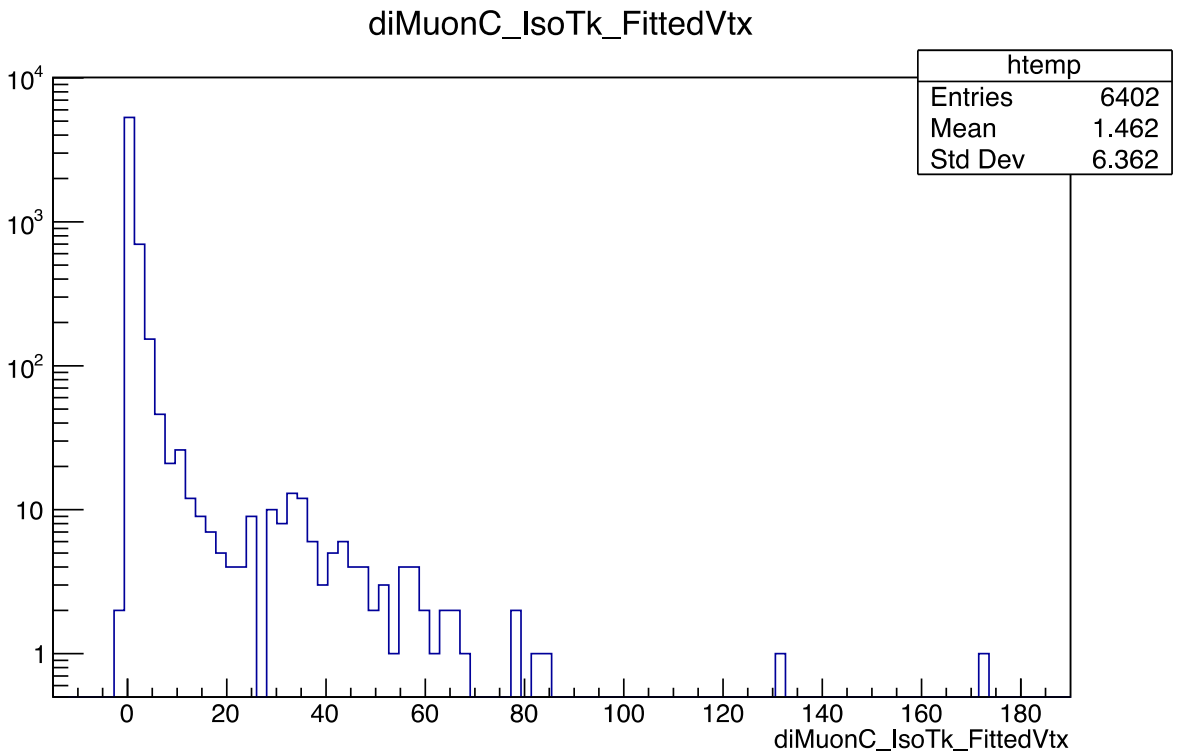
2017 MiniAOD 0p11



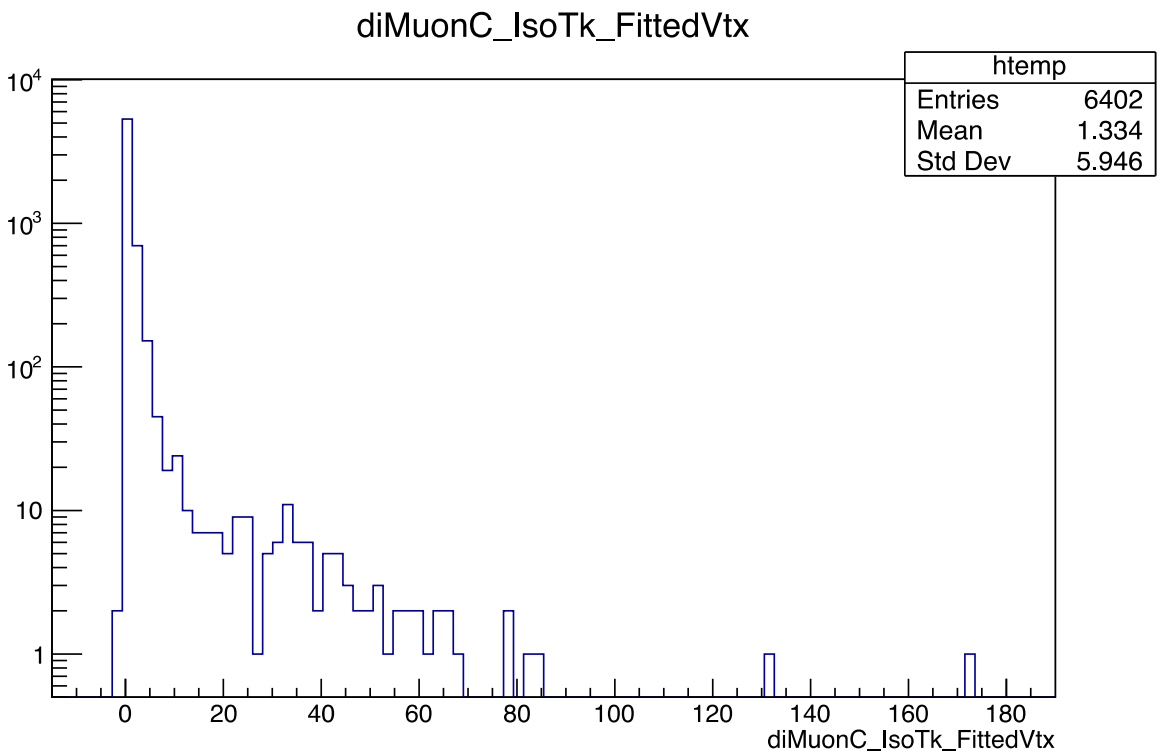
2017 AOD



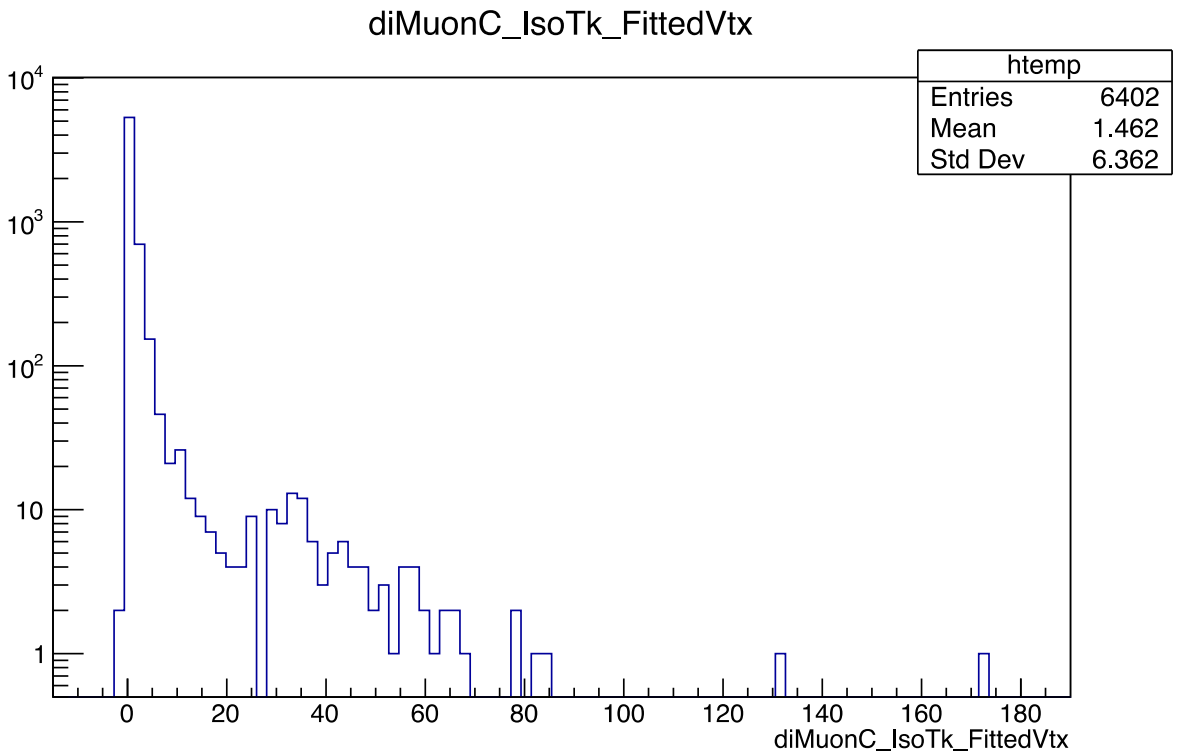
2017 MiniAOD 0p12



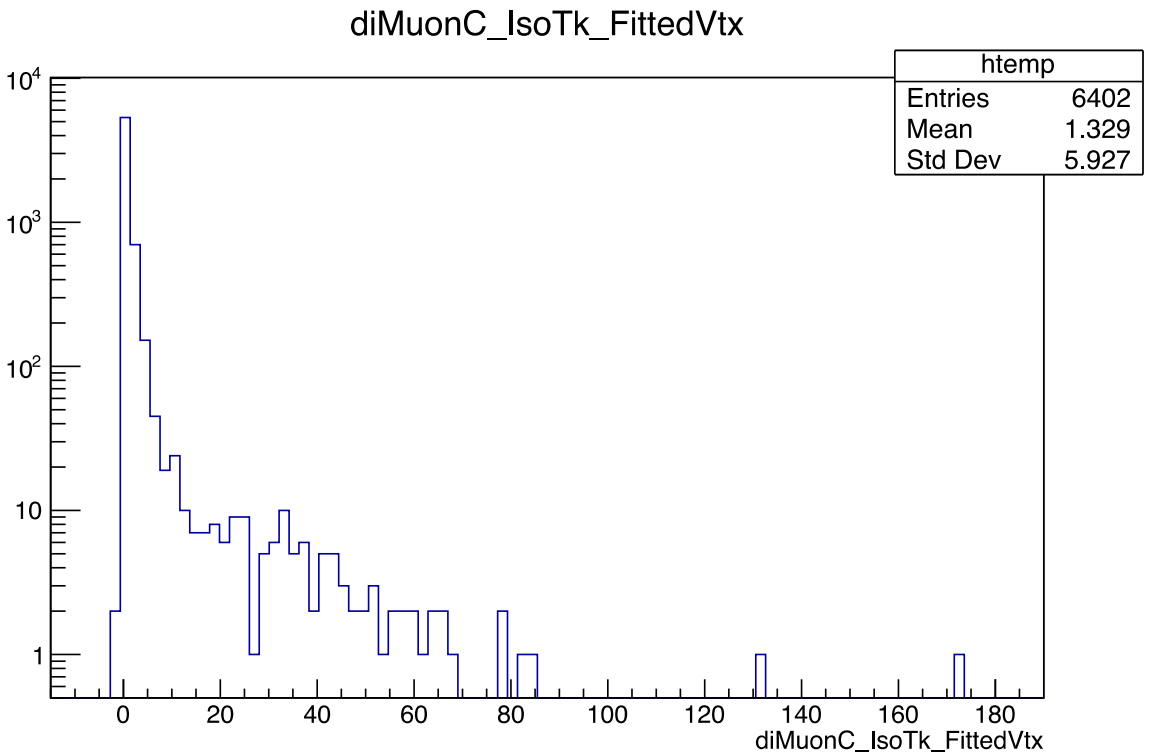
2017 AOD



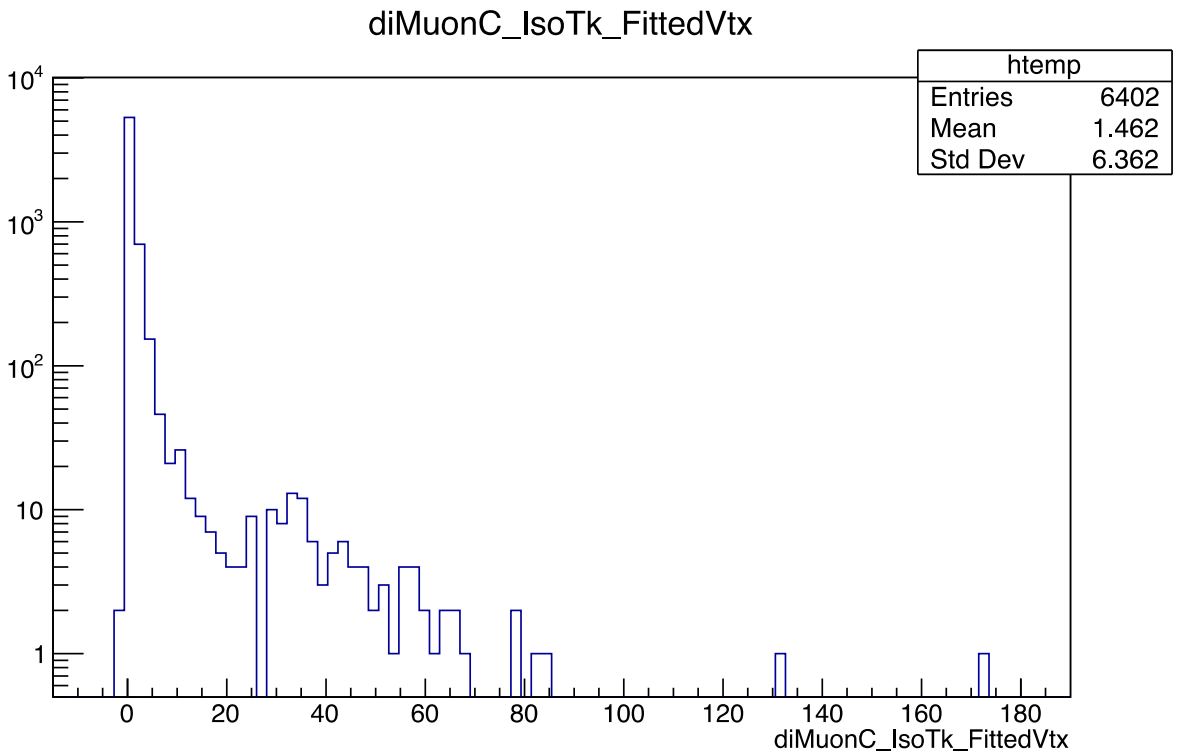
2017 MiniAOD 0p13



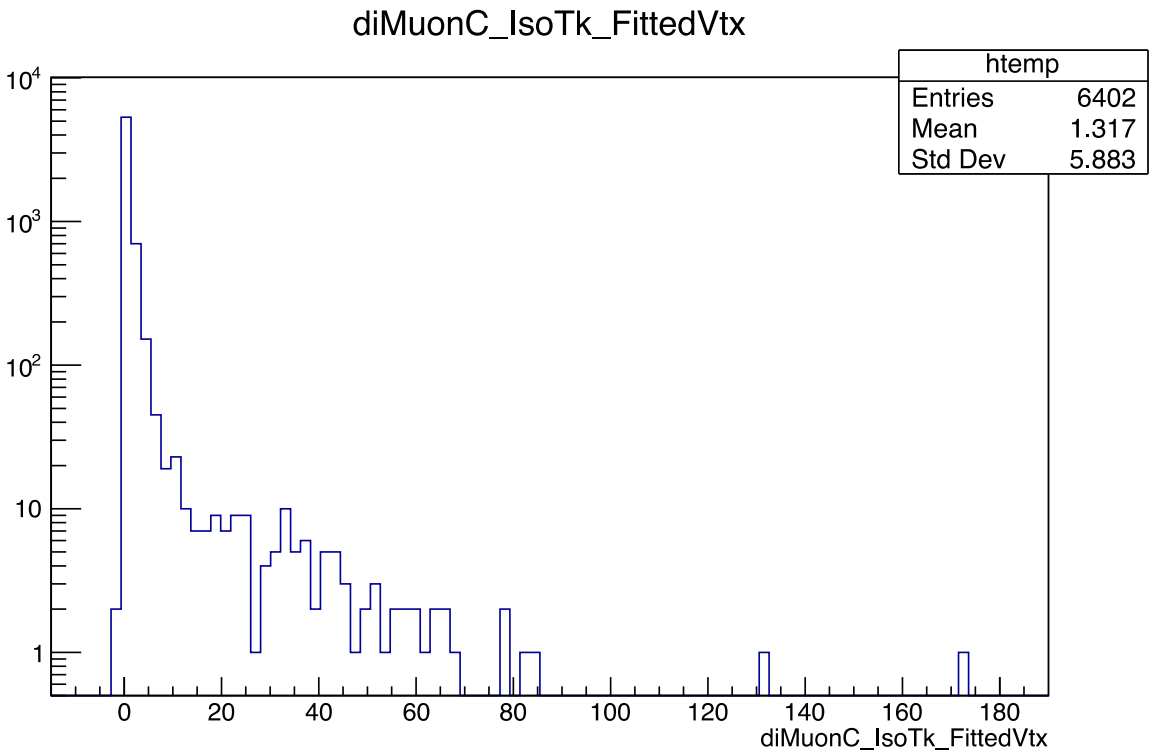
2017 AOD



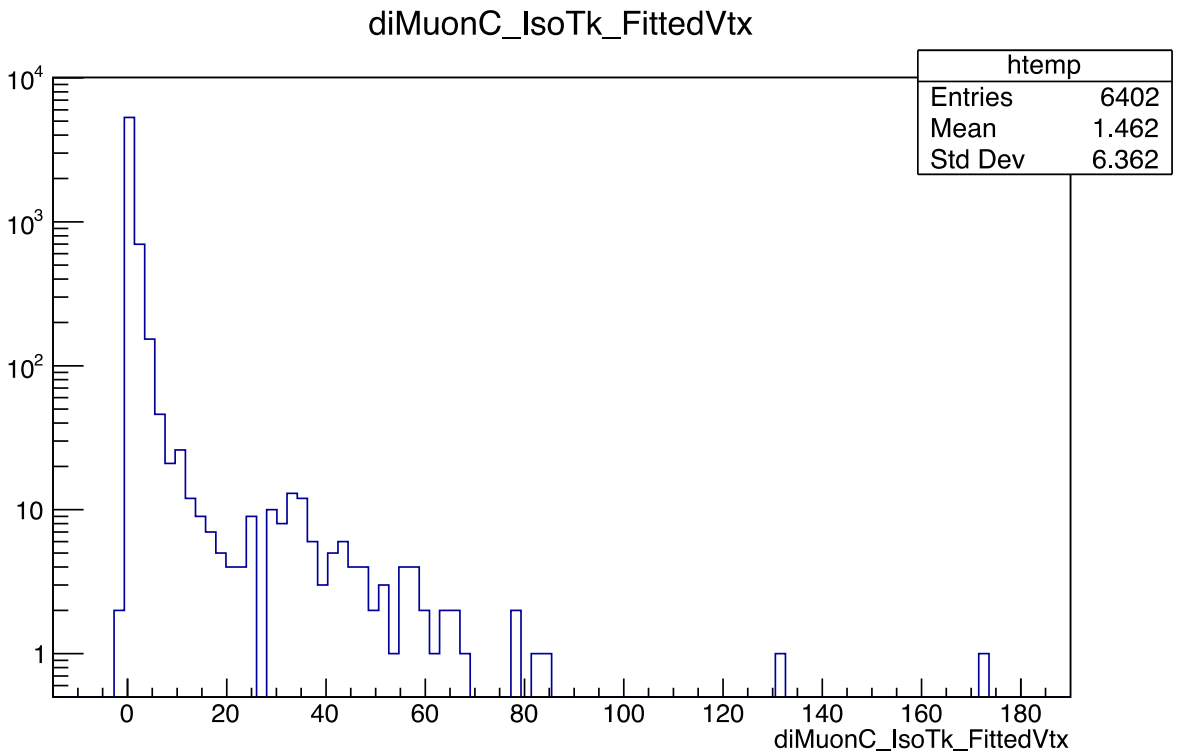
2017 MiniAOD 0p14



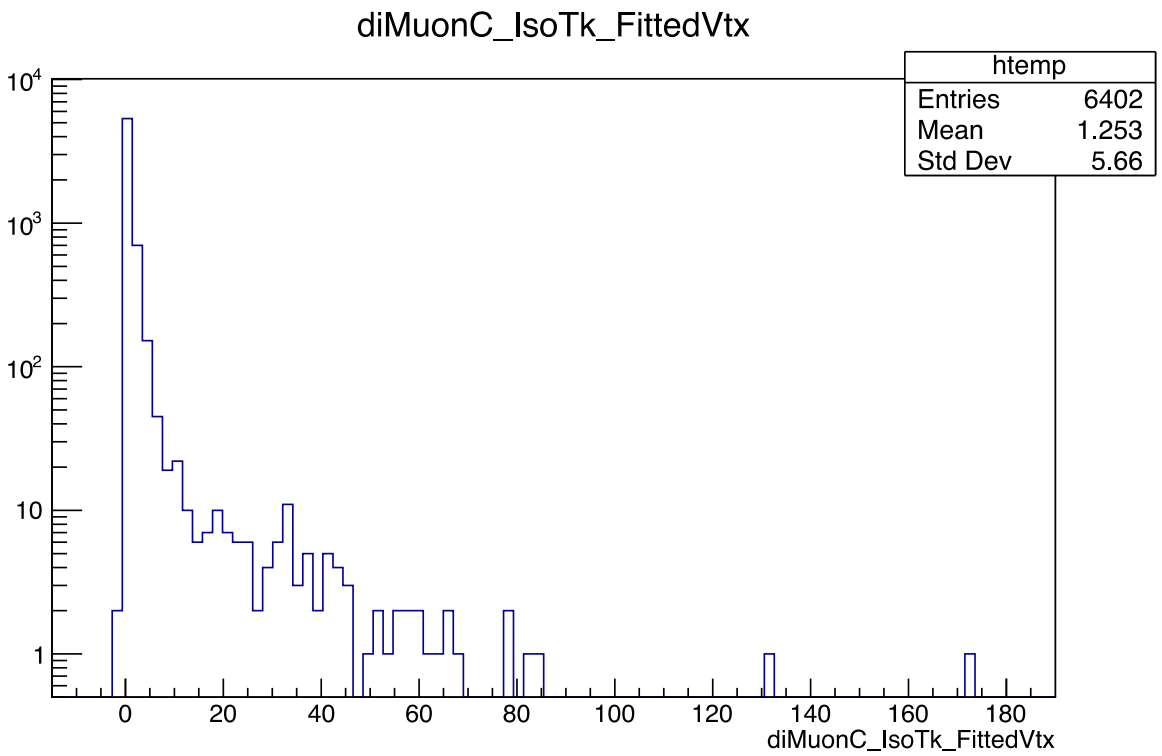
2017 AOD



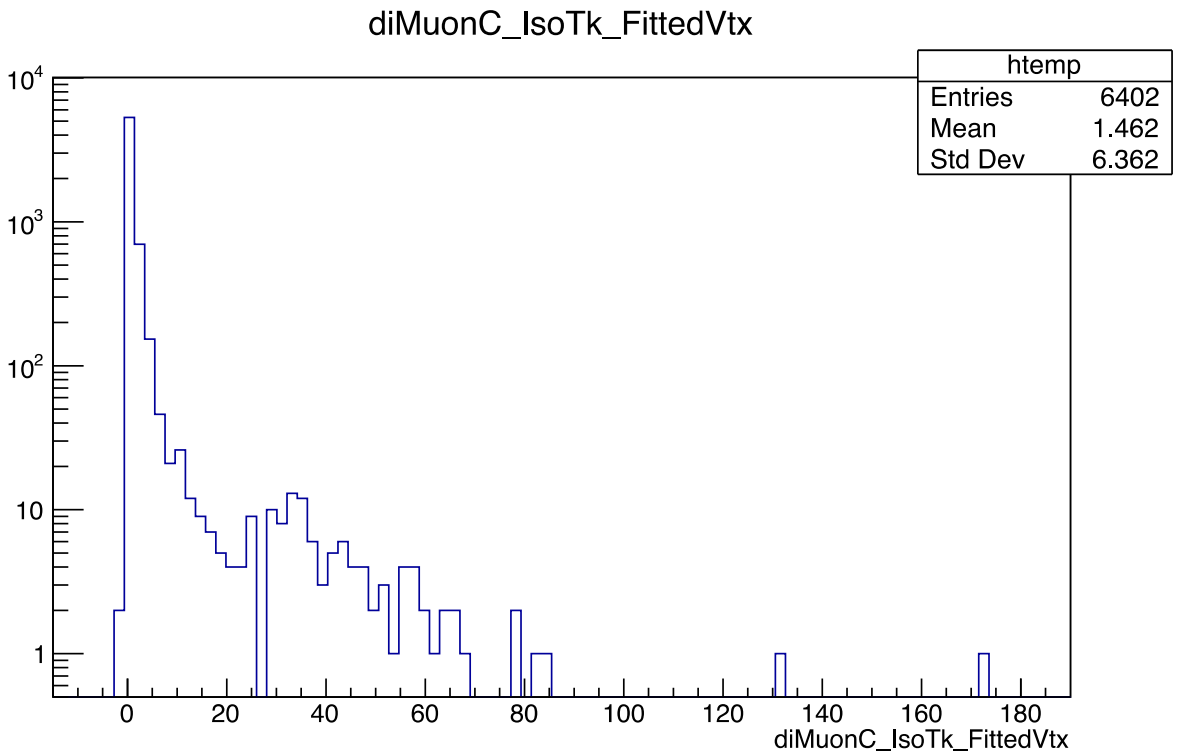
2017 MiniAOD 0p15



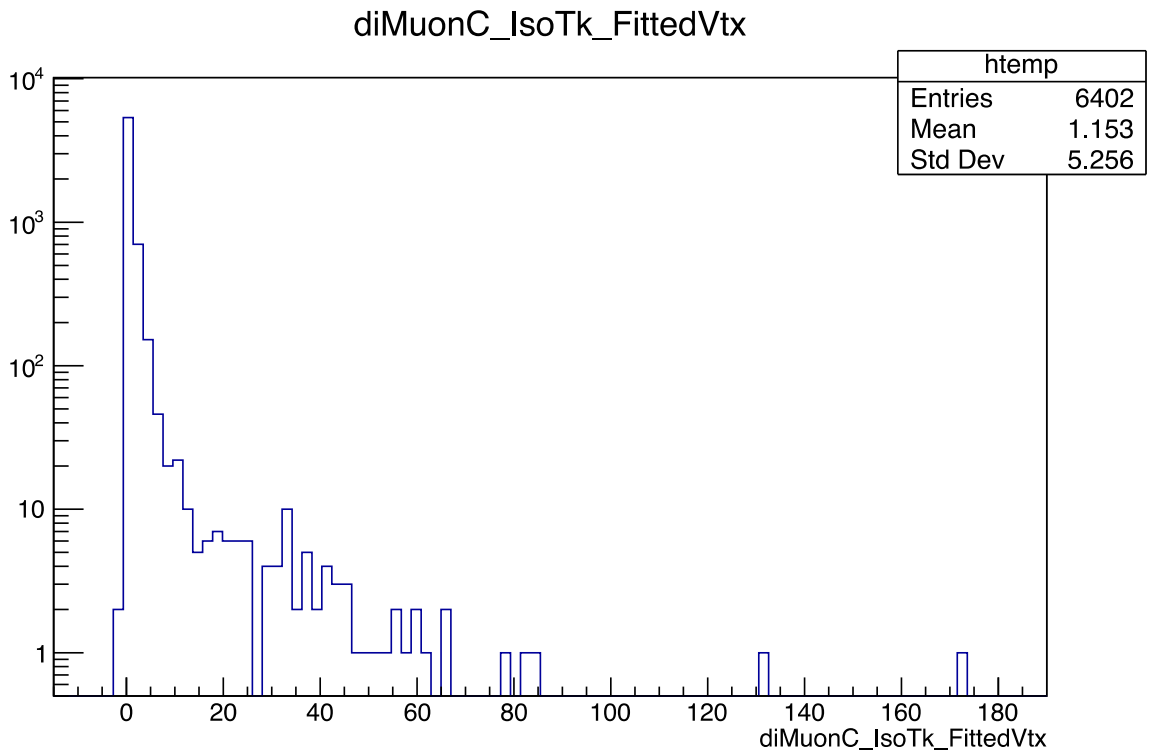
2017 AOD



2017 MiniAOD 0p2



2017 AOD



2017 MiniAOD 0p3

BACK UP

Summary

- Reduced precision in tamu::helpers::sameTrack function in MiniAOD
  - Affect dimuon/orphan muon/orphan-dimuon isolation (in backup)
  - Affect hit patterns for muons in dimuons (details in backup)
  - Solution: modify sameTrack function precision
- "patTriggerEvent" not applicable in MiniAOD
  - Affect isDimuonHLTFired
  - Solution: add if(trRes->accept(itrig)) before push back b_hltPaths branch
- Vertex→tracksSize() method not valid in MiniAOD
  - Affect primary vertex validity: isVertexOK
  - Affect closest primary vertex choice: closestPrimaryVertex, b_diMuonC_FittedVtx_Lxy_rclstvtx, b_diMuonF_FittedVtx_Lxy_rclstvtx
  - Solution: change vertex input to unpackedTracksAndVertices in python config file
- Gen particles: same b/t AOD and MiniAOD (10000 events in backup)

- Reference: https://github.com/weishi10141993/MuJetAnalysis/blob/for-CMSSW-80X-NoPHR-RAWAODSIM/CutFlowAnalyzer/plugins/CutFlowAnalyzer_MiniAOD.cc

- *** Number of tracks 643
- @@@ i = 1
- diMuon 1: vertex x -0.75075: vertex y 0.338165: vertex z -3.21298
- vertex phi 2.94387; vertex eta 0.862438; vertex dz -2.98859
- vertex px -35.304: vertex py 7.07265: vertex pz 35.0477
- muon_0 px -19.6833; muon_0 py 3.81264; muon_0 pz 19.6421; muon_0 pt 20.0491
- muon_0 vx 0.105549; muon_0 vy 0.172348; muon_0 vz -4.06929
- muon_1 px -15.6208; muon_1 py 3.26005; muon_1 pz 15.4056; muon_1 pt 15.9574
- muon_1 vx 0.103043; muon_1 vy 0.160077; muon_1 vz -4.05337
- trackIsMuon0:0 ➔ diMuonTmp->sameTrack(&*track, &*(diMuonTmp->muon(0)->innerTrack()))
- trackIsMuon1:1
- trackIsMuon000:0 → tamu::helpers::sameTrack(&*track, &*(diMuonTmp->muon(0)->innerTrack()))
- trackIsMuon111:1
- @@@ track number: 641
- >>> This track is used in dimuon <<<
- track px -15.6208; track py 3.26005; track pz 15.4056; track pt 15.9574
- track vx 0.103043; track vy 0.160077; track vz -4.05337
- trackIsMuon0:1
- trackIsMuon1:0
- trackIsMuon000:1
- trackIsMuon111:0
- @@@ track number: 643
- >>> This track is used in dimuon <<<
- track px -19.6833; track py 3.81264; track pz 19.6421; track pt 20.0491
- track vx 0.105549; track vy 0.172348; track vz -4.06929

AOD Consistent

- *** Number of tracks 154
- @@@ i = 1
- diMuon 1: vertex x -0.75075: vertex y 0.338165: vertex z -3.21298
- vertex phi 2.94387; vertex eta 0.862438; vertex dz -2.98859
- vertex px -35.304: vertex py 7.07265: vertex pz 35.0477
- muon_0 px -19.6833; muon_0 py 3.81264; muon_0 pz 19.6421; muon_0 pt 20.0491
- muon_0 vx 0.105549; muon_0 vy 0.172348; muon_0 vz -4.06929
- muon_1 px -15.6208; muon_1 py 3.26005; muon_1 pz 15.4056; muon_1 pt 15.9574
- muon_1 vx 0.103043; muon_1 vy 0.160077; muon_1 vz -4.05337
- trackIsMuon0:0 → diMuonTmp->sameTrack(&*track, &*(diMuonTmp->muon(0)->innerTrack()))
- trackIsMuon1:0
- trackIsMuon000:1 → tamu::helpers::sameTrack(&*track, &*(diMuonTmp->muon(0)->innerTrack()))
- trackIsMuon111:0
- ### Satisfy isolation requirement ###
- @@@ track number: 3
- track px -19.6812; track py 3.81175; track pz 19.6423
- track vx 0.0894595; track vy 0.175465; track vz -4.05324
- track phi 2.95029; track eta 0.867031; track z -2.99589
- track pt 20.0469; dR 0.00788699; Iso_dz 0.00730146; diMuonTmp_Iso 20.0469
- trackIsMuon0:0
- trackIsMuon1:0
- trackIsMuon000:0
- trackIsMuon111:1
- ### Satisfy isolation requirement ###
- @@@ track number: 4
- track px -15.6243; track py 3.26102; track pz 15.4105
- track vx 0.0869471; track vy 0.163431; track vz -4.0375
- track phi 2.93583; track eta 0.856777; track z -2.97997
- track pt 15.9609; dR 0.00983577; Iso_dz 0.00861957; diMuonTmp_Iso 36.0078

MiniAOD

Inconsistent: true for 2016 and 2017

Propose to change

diMuonTmp->sameTrack(&*track, &*(diMuonTmp->muon(0)->innerTrack()))

to

tamu::helpers::sameTrack(&*track, &*(diMuonTmp->muon(0)->innerTrack()))

In the miniAOD analyzer

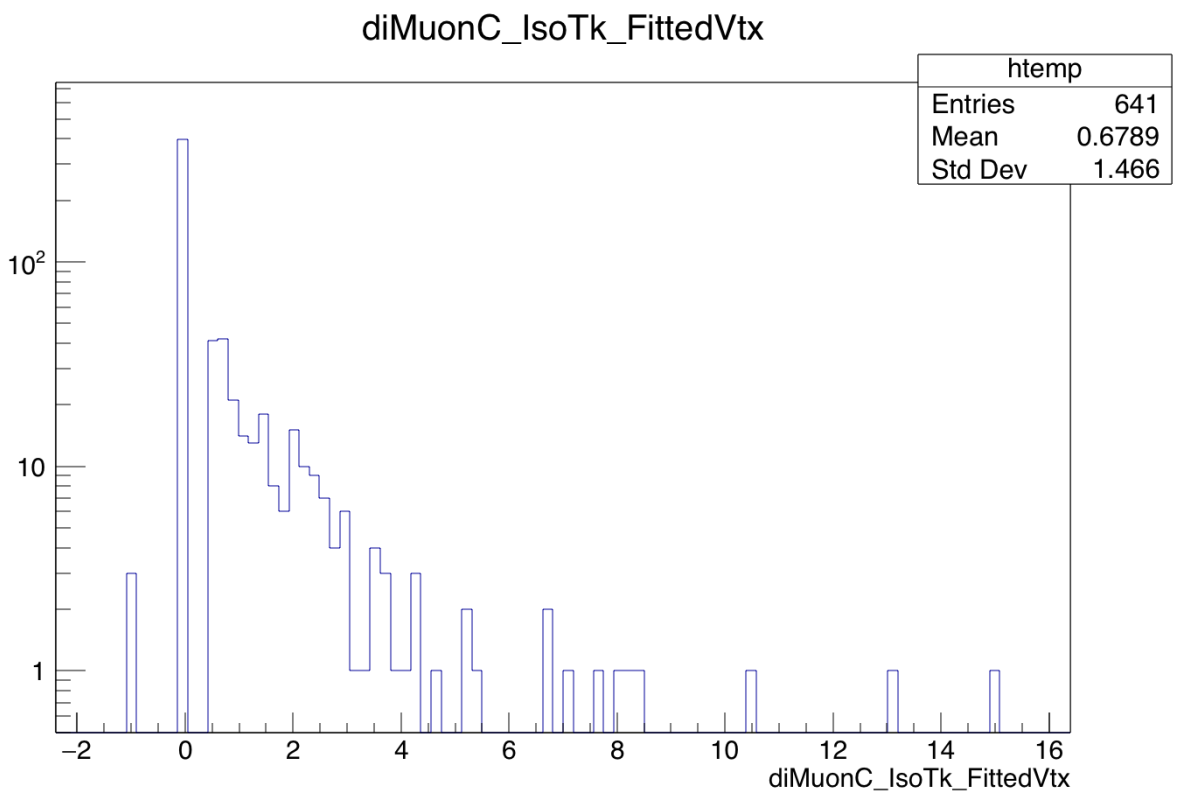
Checks of 10000 MC events 2016

- Vary the sametrack function 1e-10
  - Cutflow table always same
  - Isolation branches
  - Hitpatterns branches

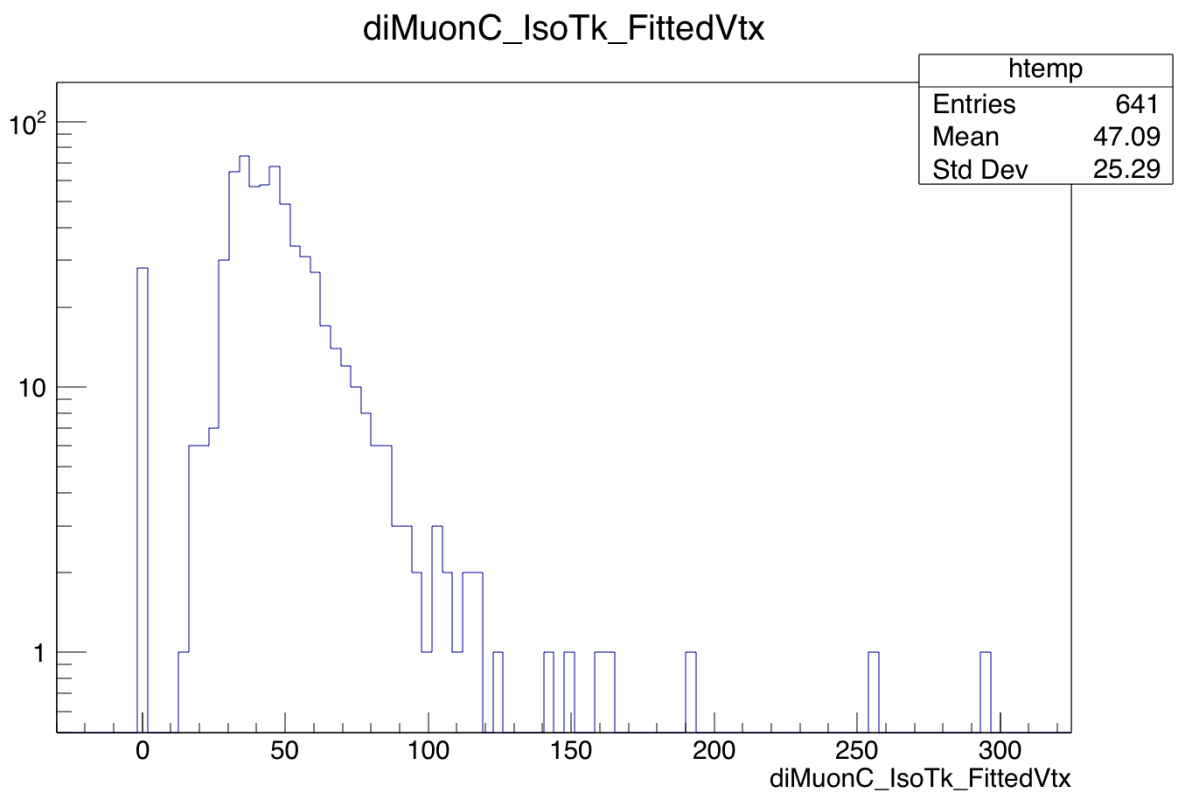
```
bool tamu::helpers::sameTrack(const reco::Track *one, const reco::Track *two) {
  return (fabs(one->px() - two->px()) < 1e-10  &&
          fabs(one->py() - two->py()) < 1e-10  &&
          fabs(one->pz() - two->pz()) < 1e-10  &&
          fabs(one->vx() - two->vx()) < 1e-10  &&
          fabs(one->vy() - two->vy()) < 1e-10  &&
          fabs(one->vz() - two->vz()) < 1e-10);
}
```

SameTrack 1e-10

AOD

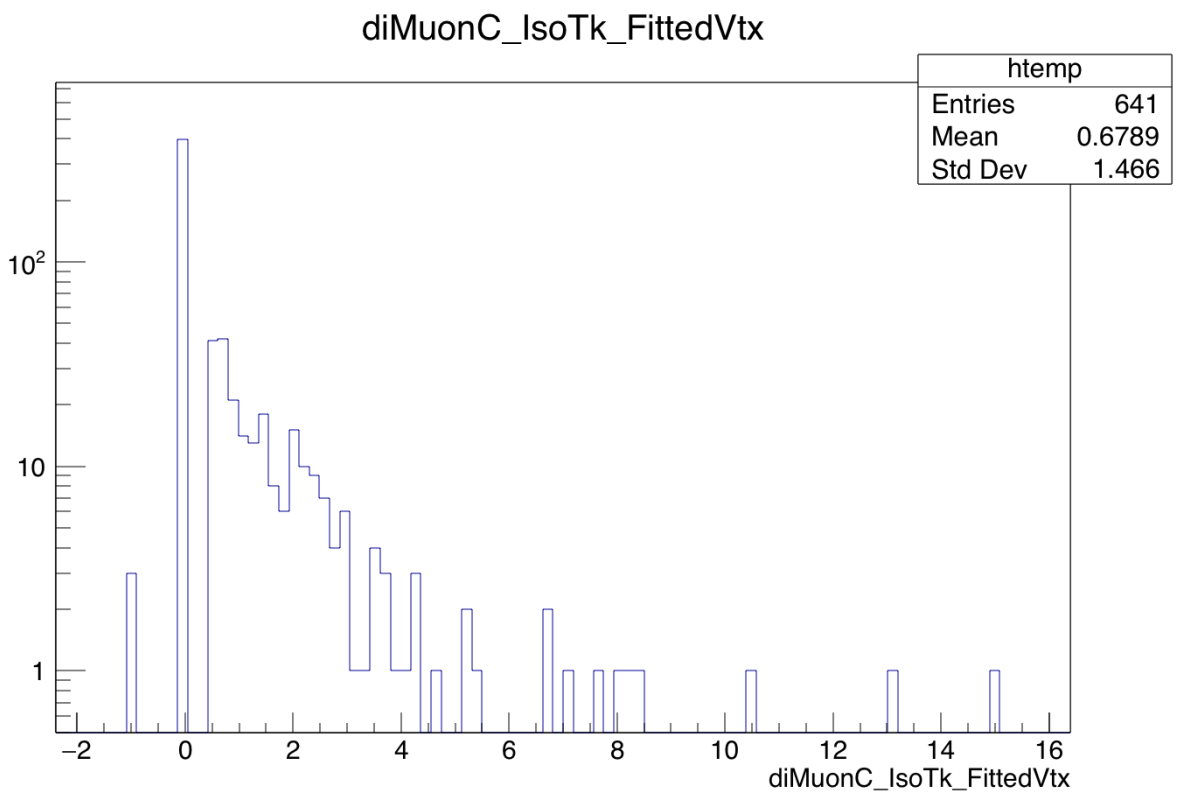


MiniAOD

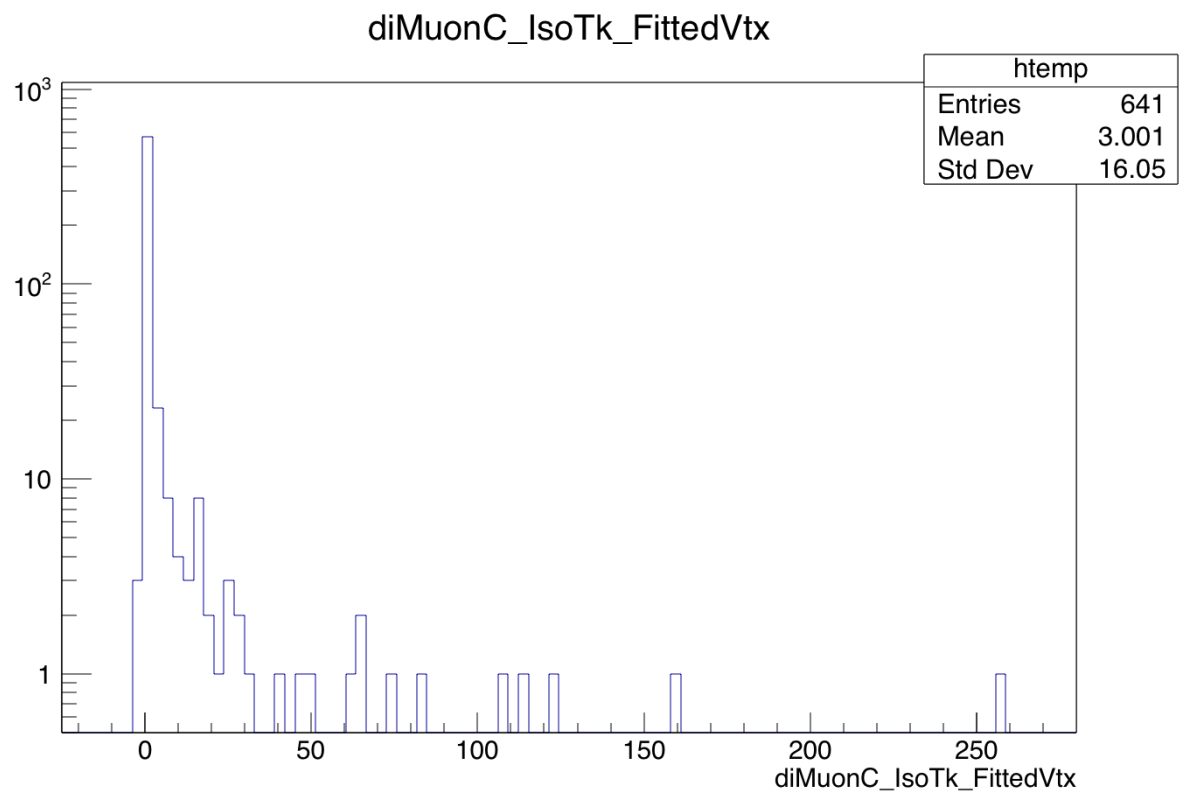


SameTrack 0.02

AOD

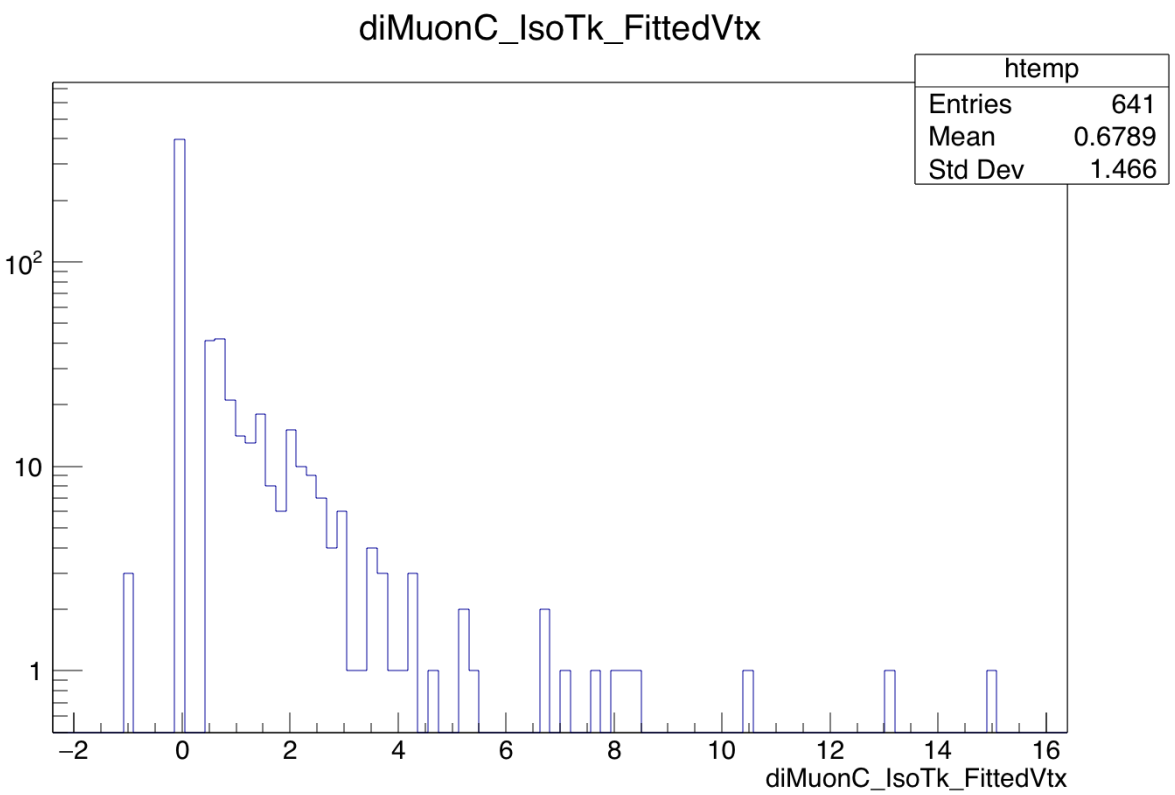


MiniAOD

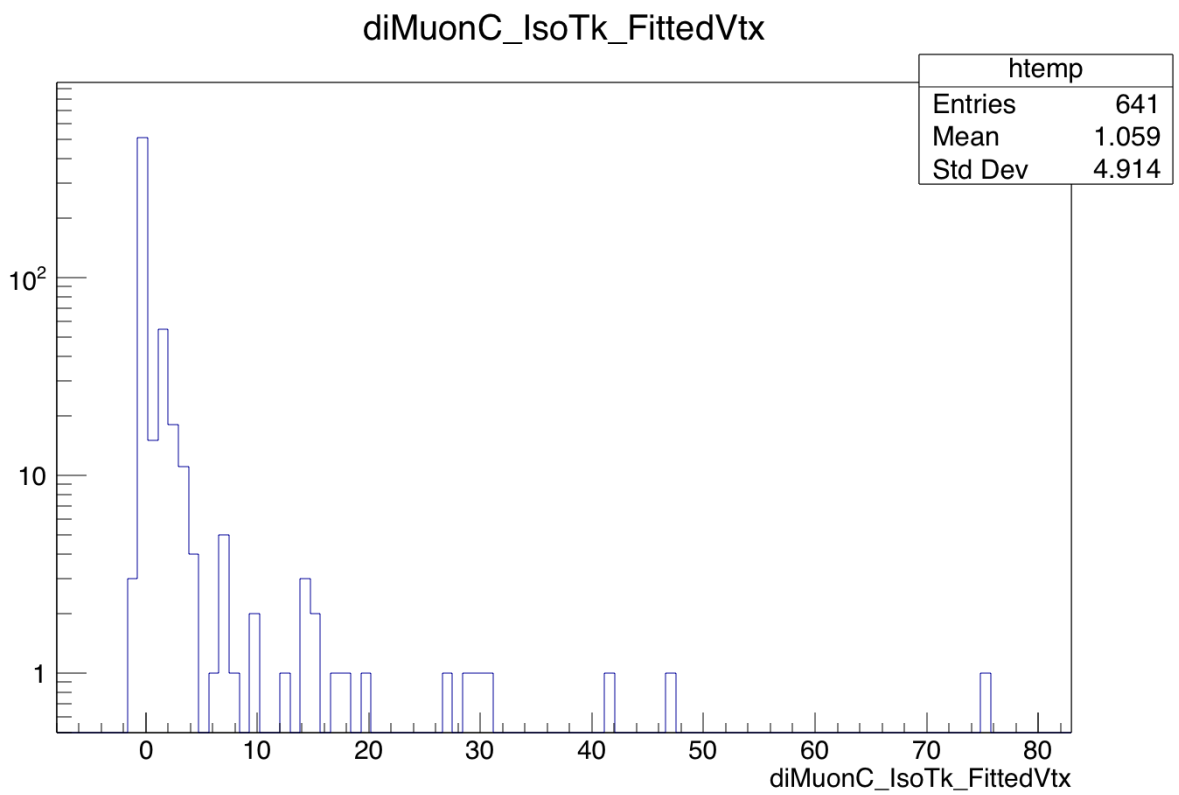


SameTrack 0.05

AOD

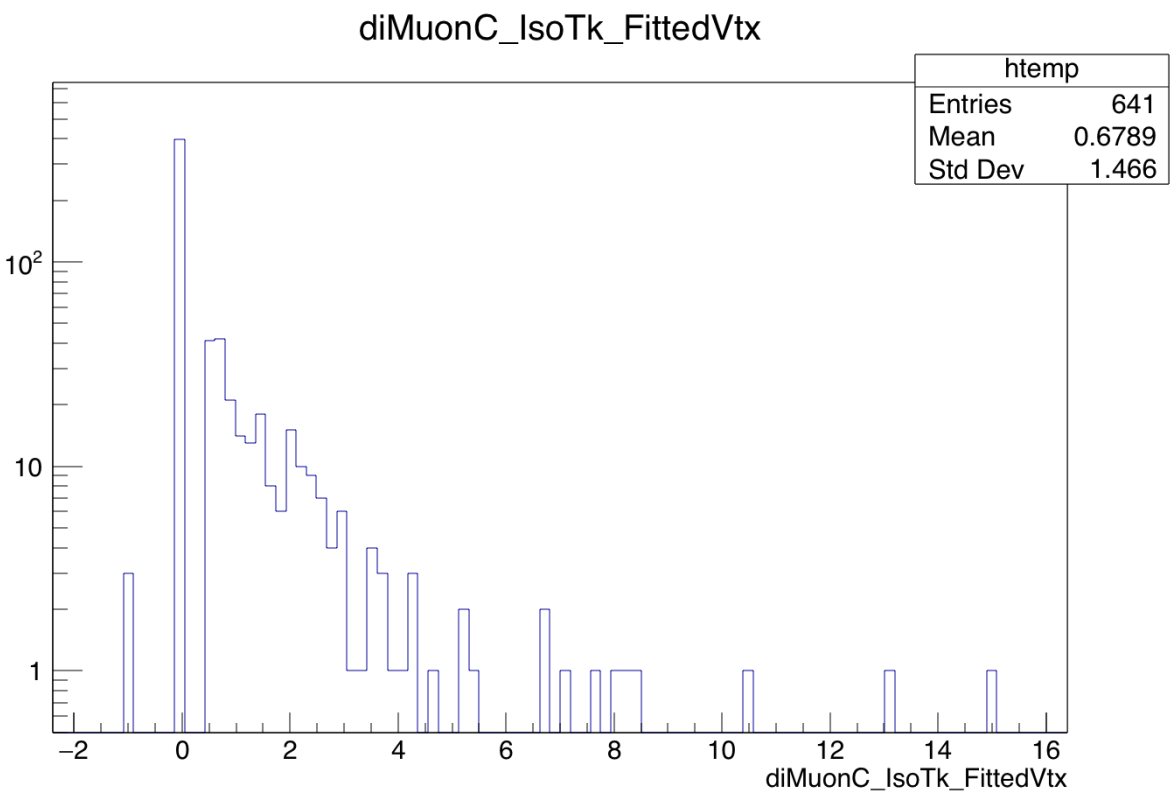


MiniAOD



SameTrack 0.1

AOD



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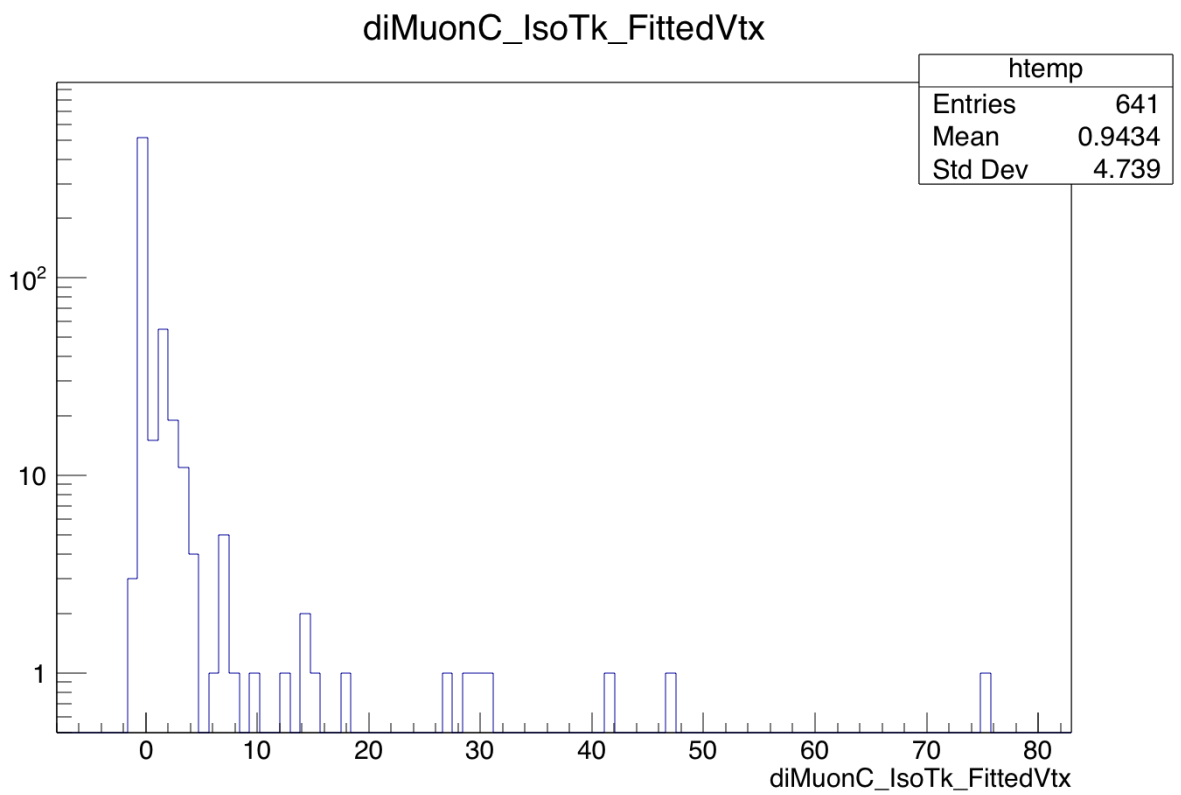

SameTrack 0.13

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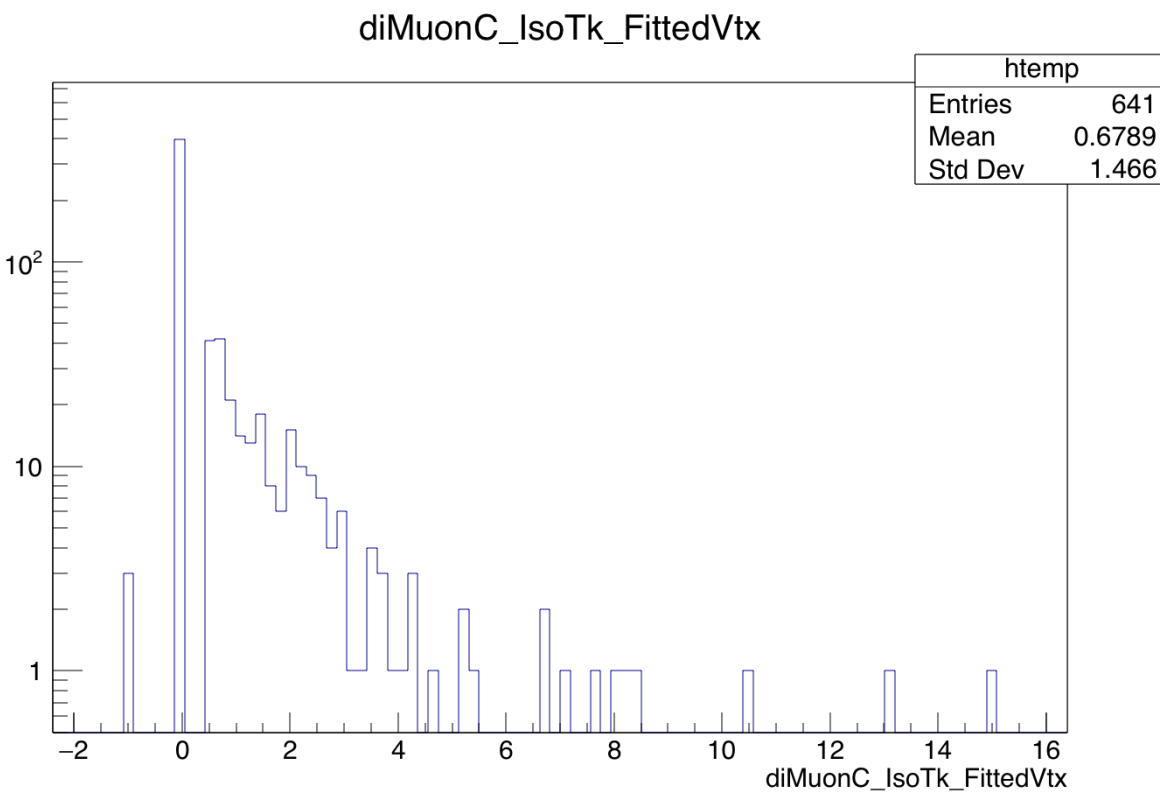

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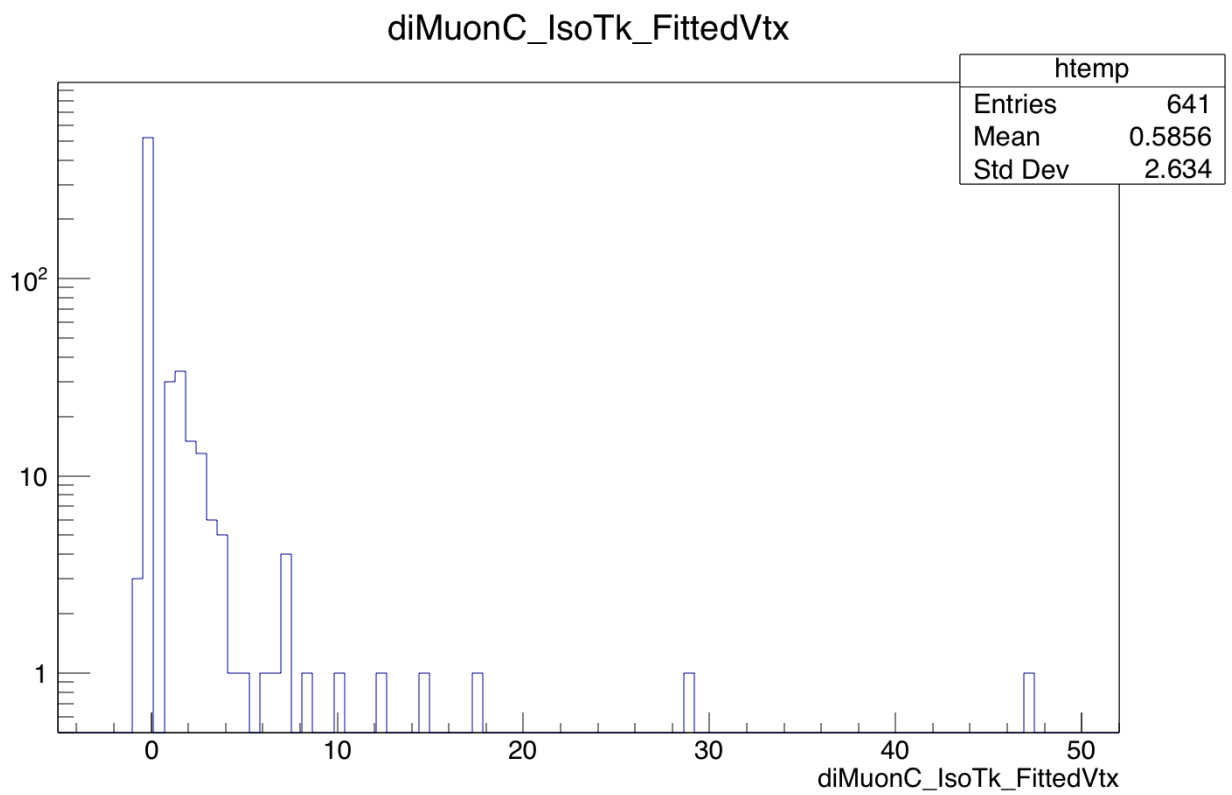

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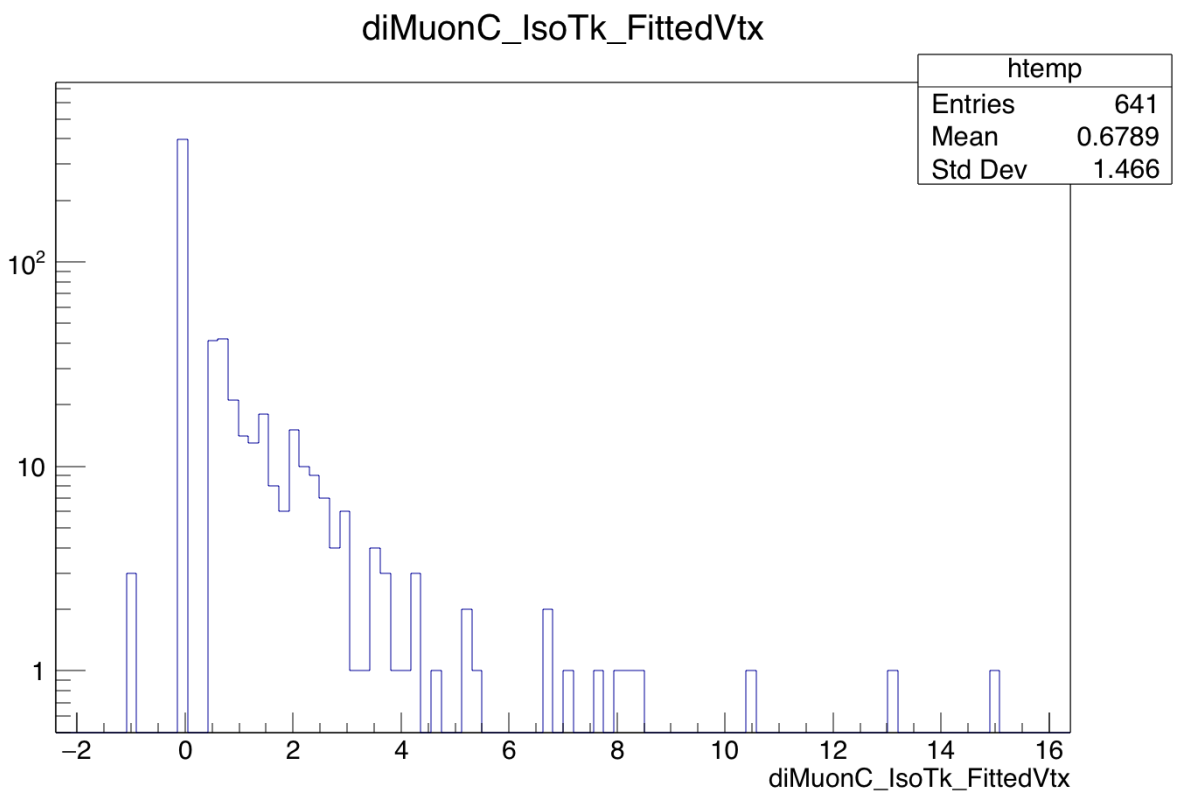

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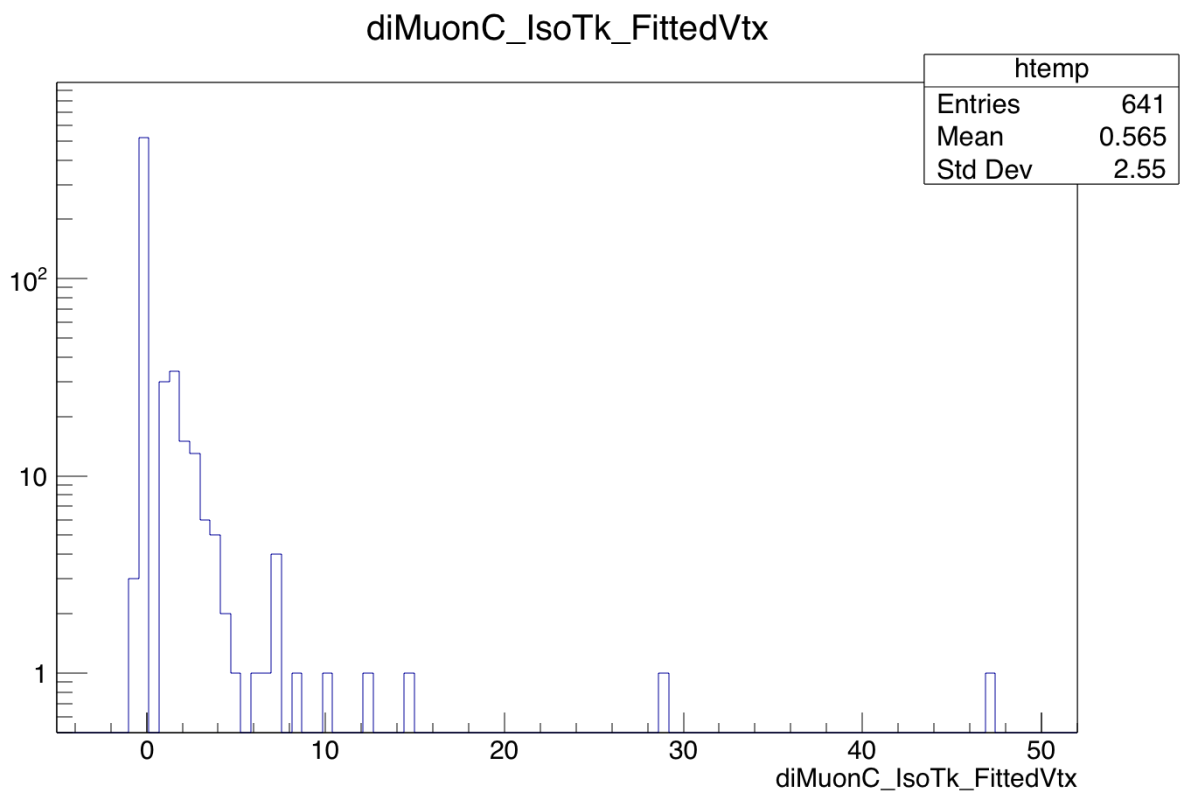

SameTrack 0.2

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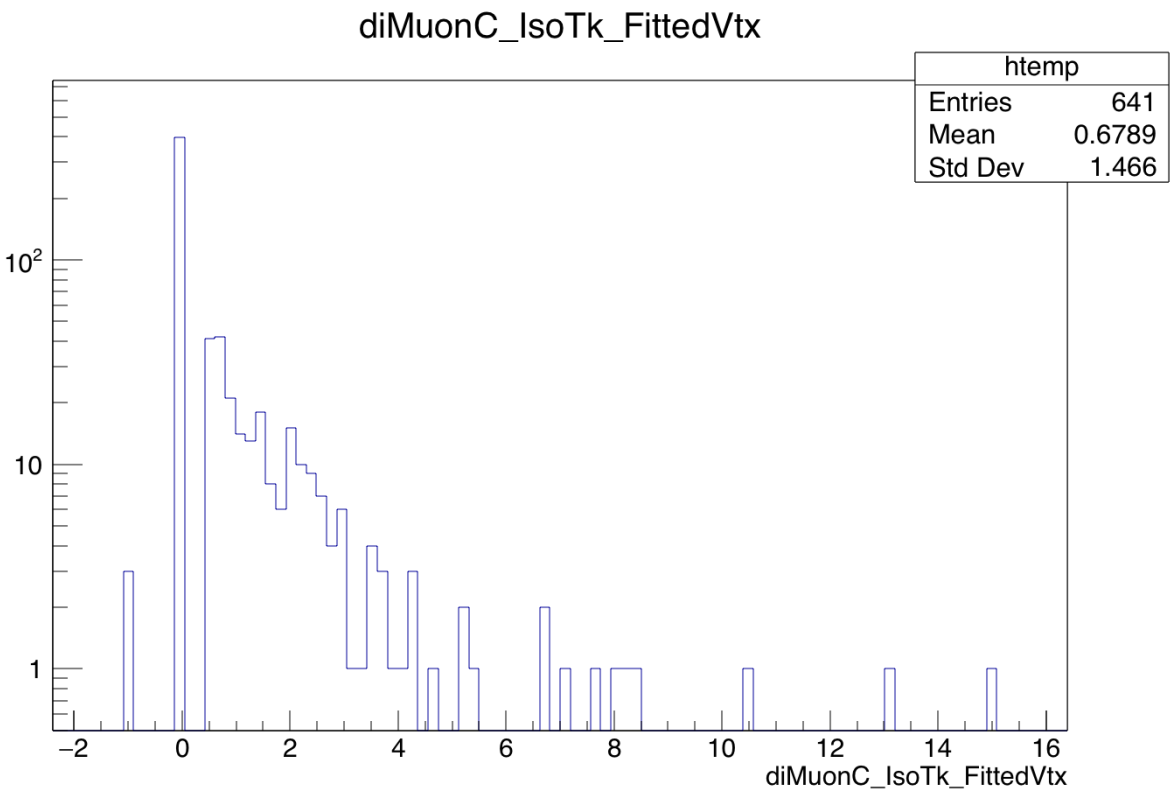

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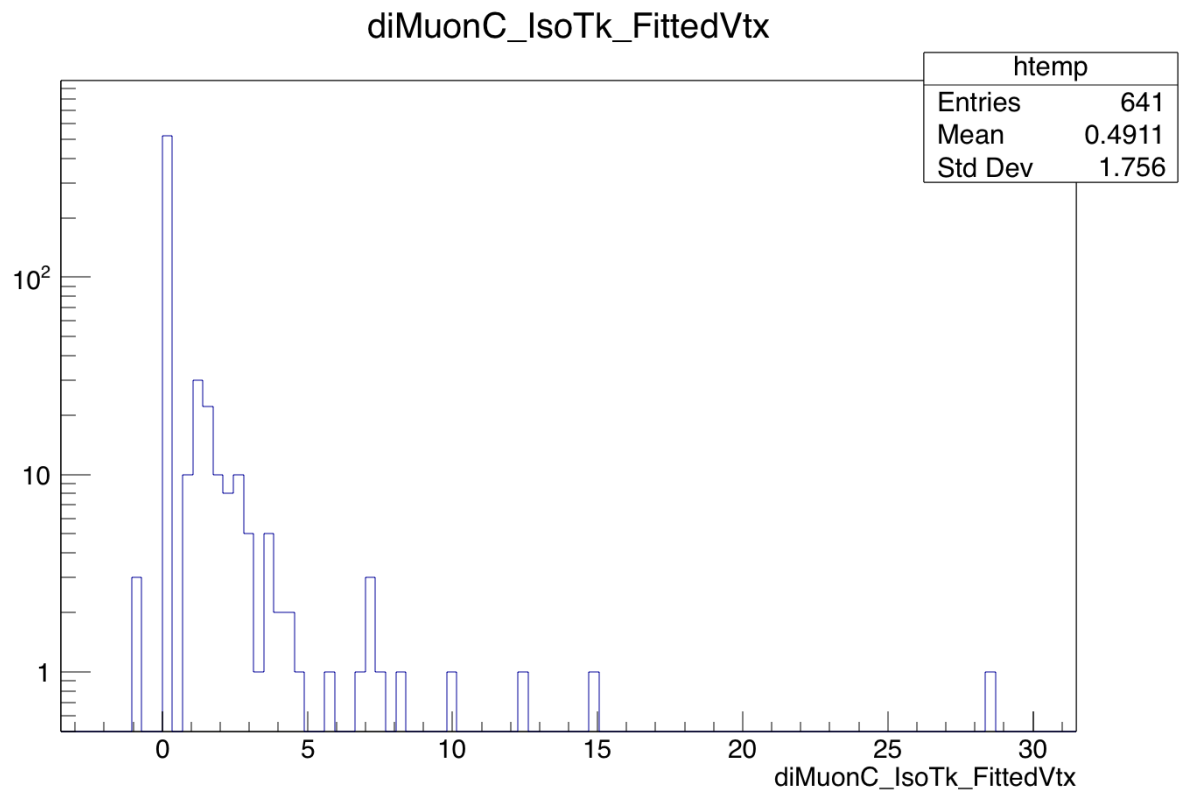

SameTrack 0.3

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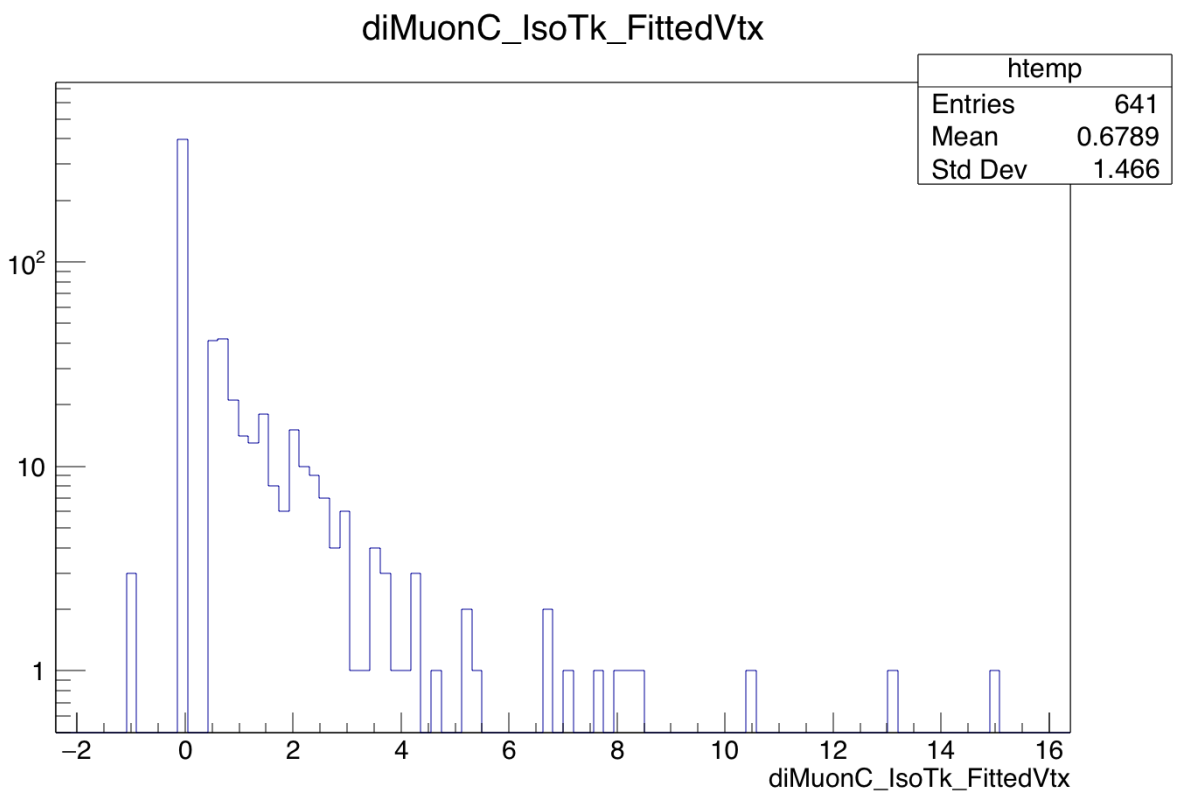

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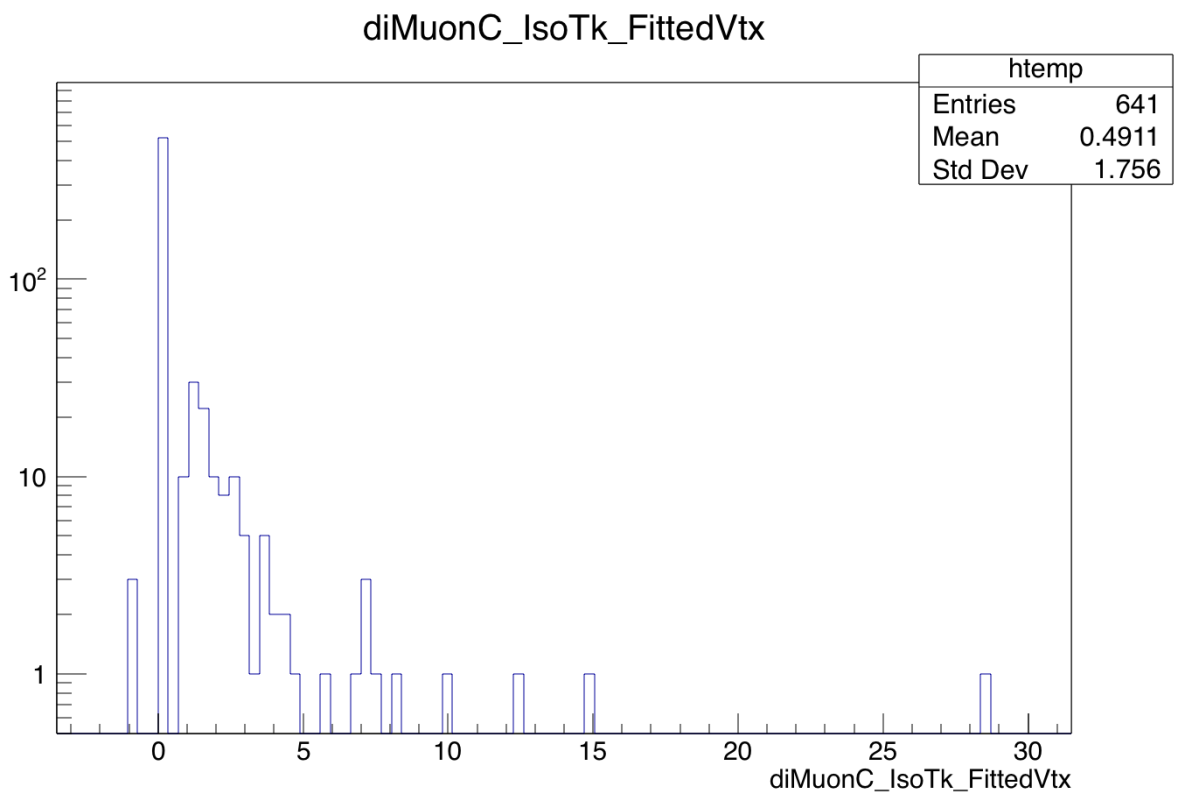

SameTrack 0.4

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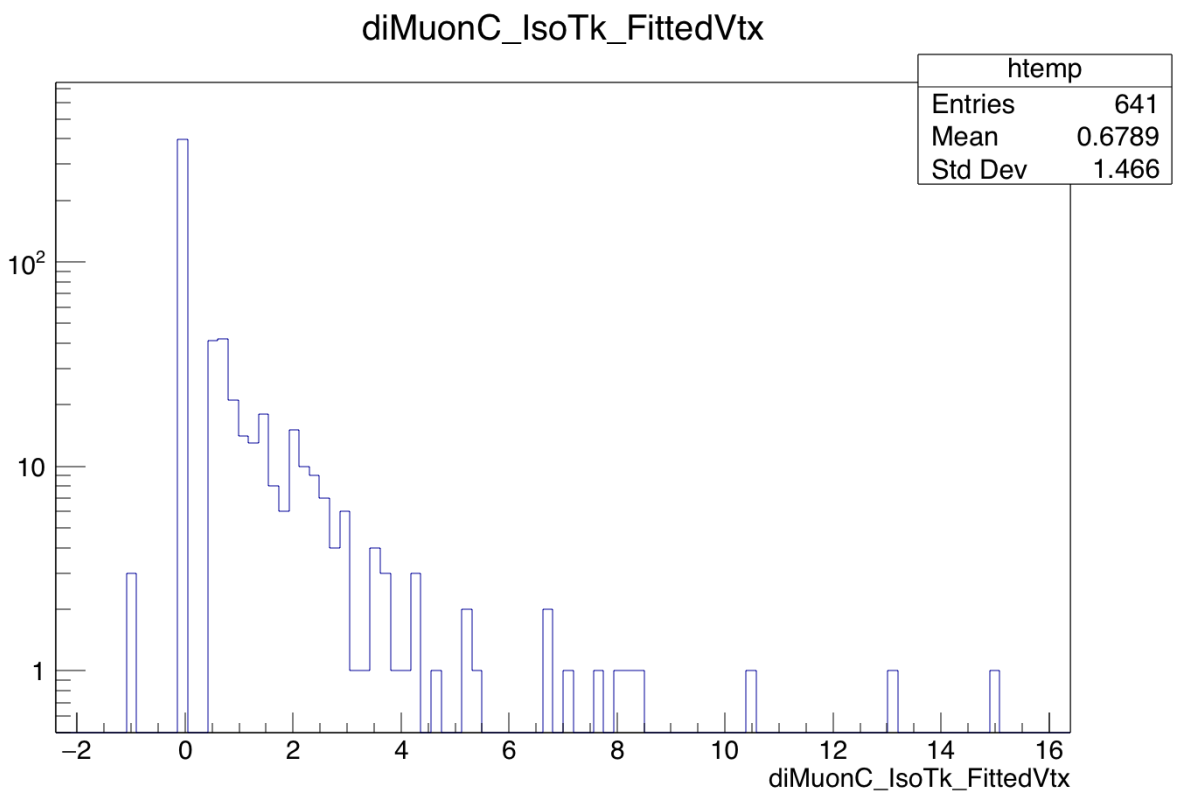

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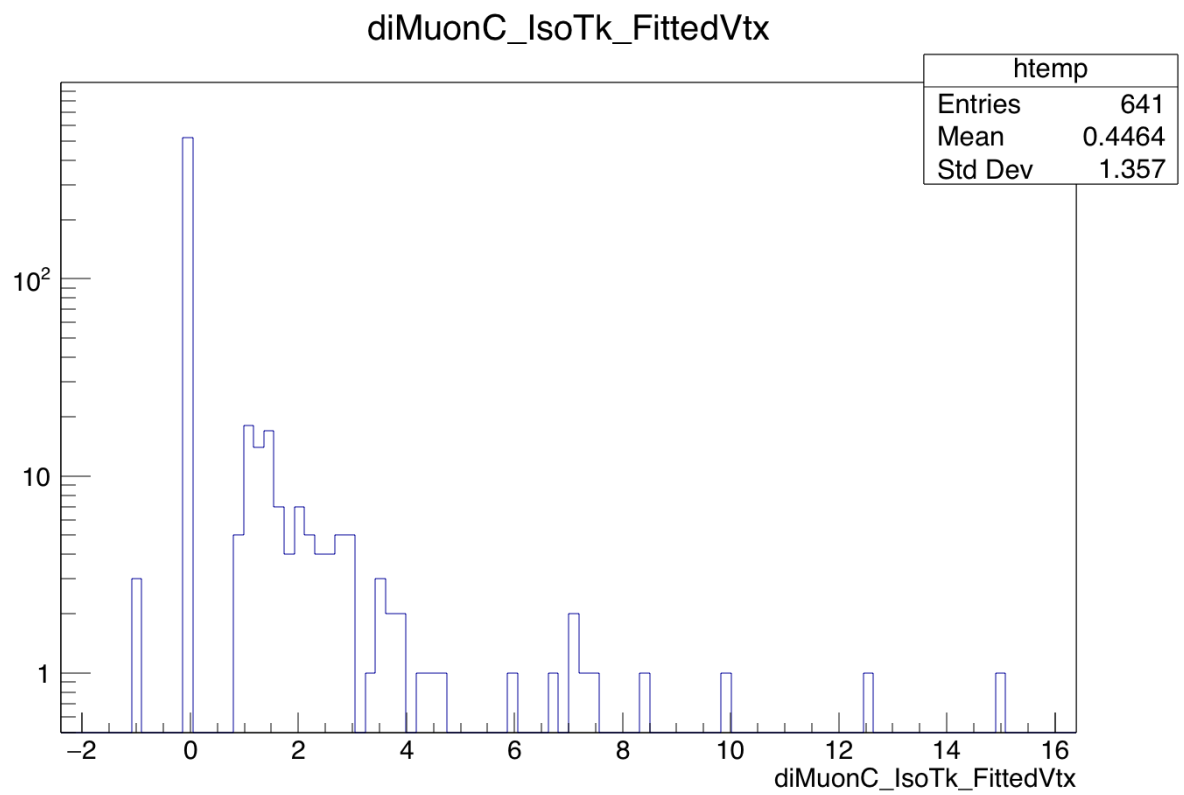

SameTrack 0.5

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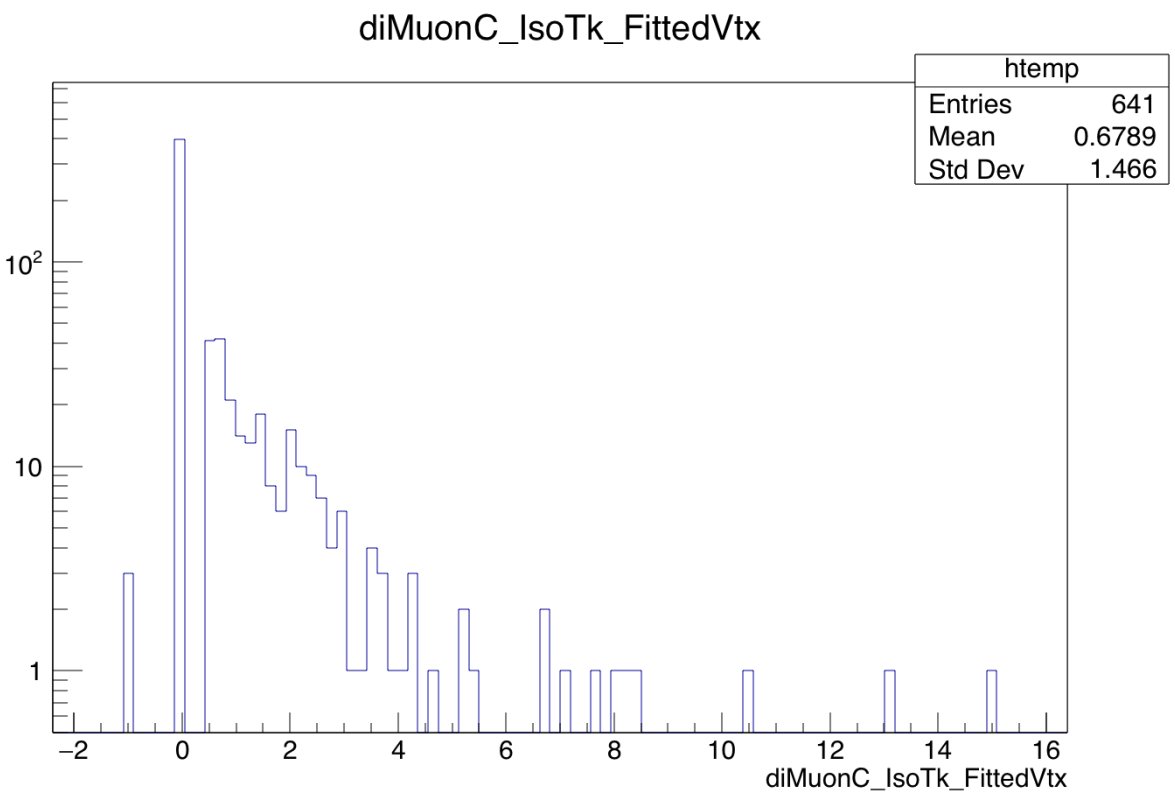

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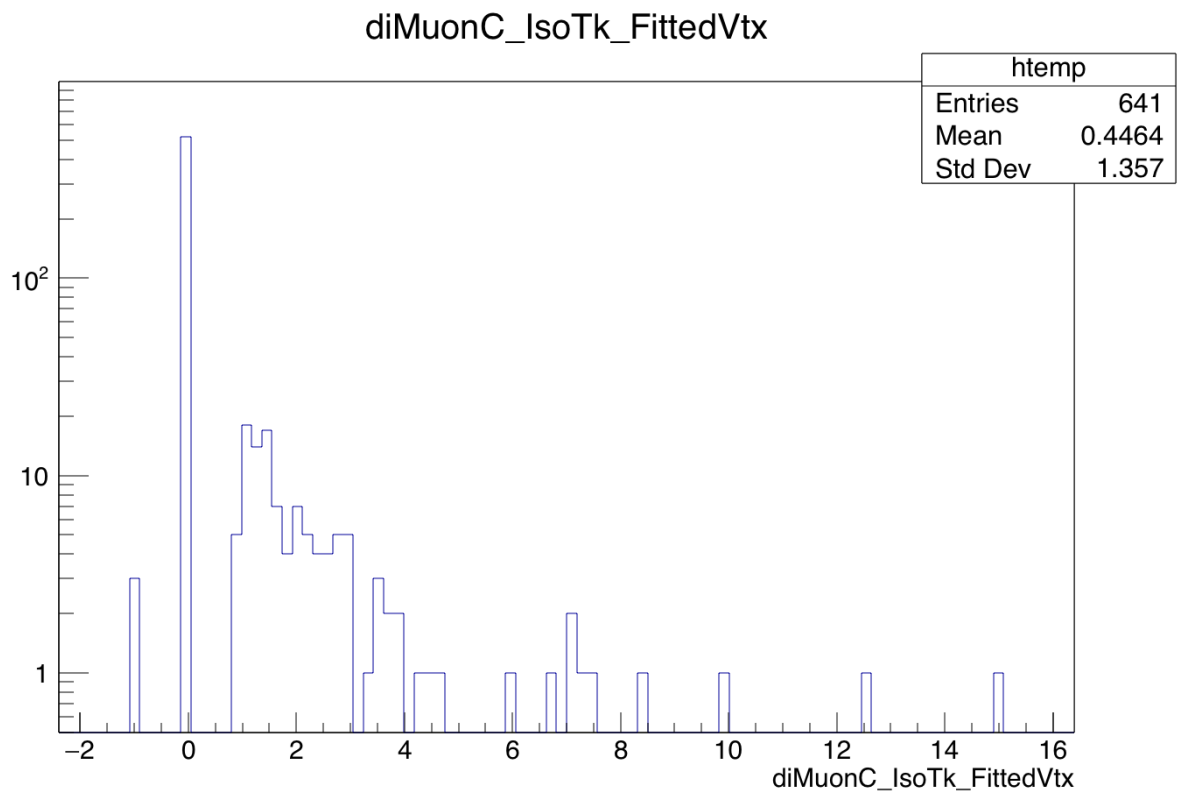

SameTrack 0.6

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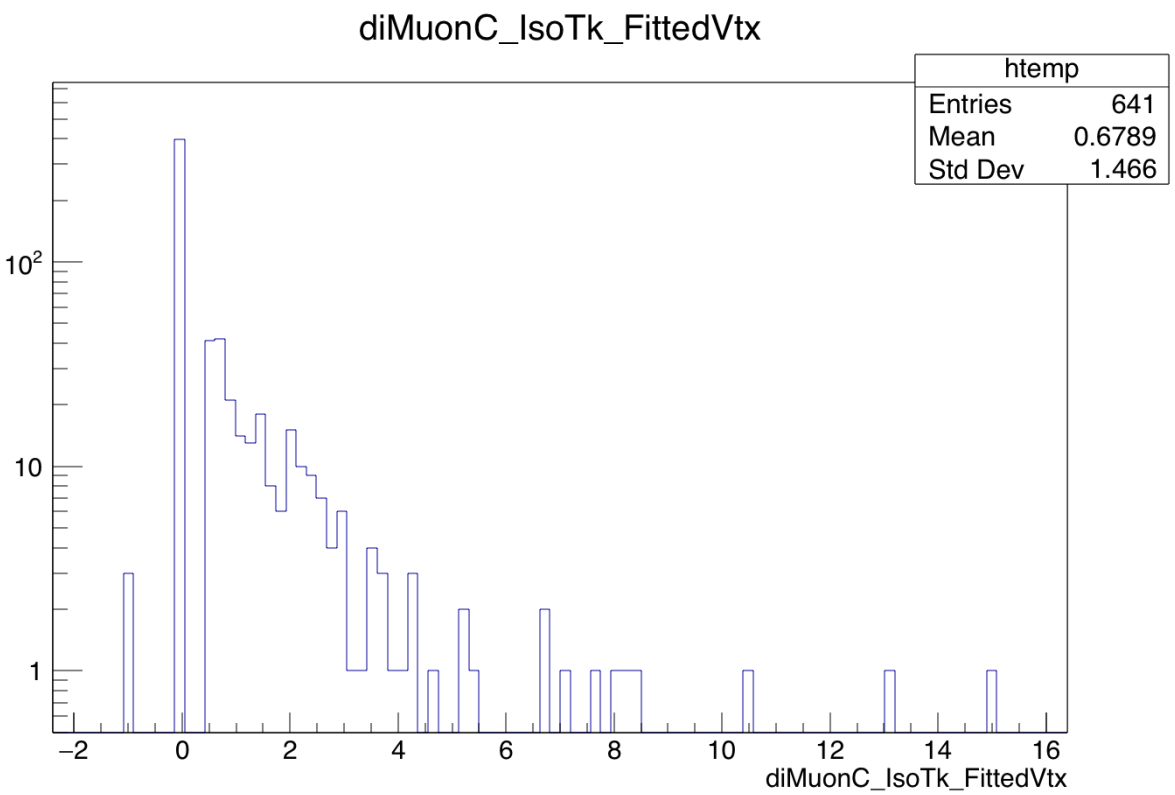

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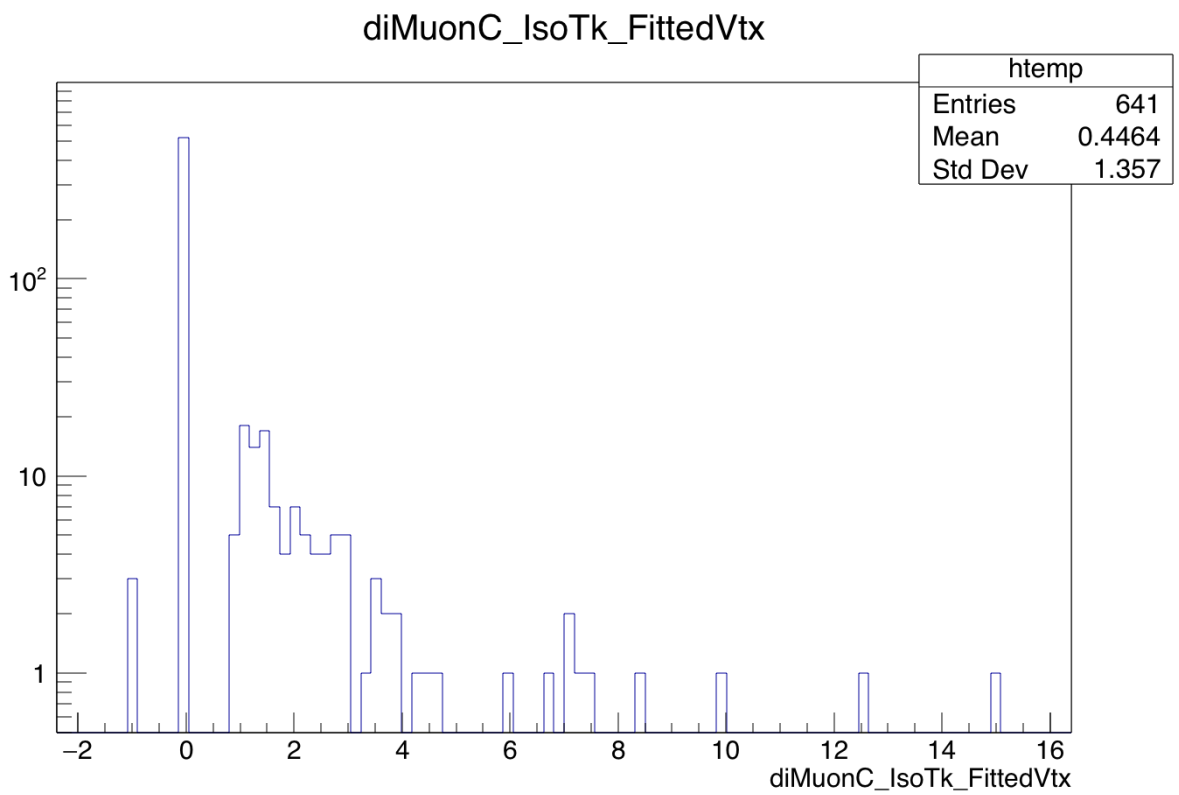

SameTrack 0.7

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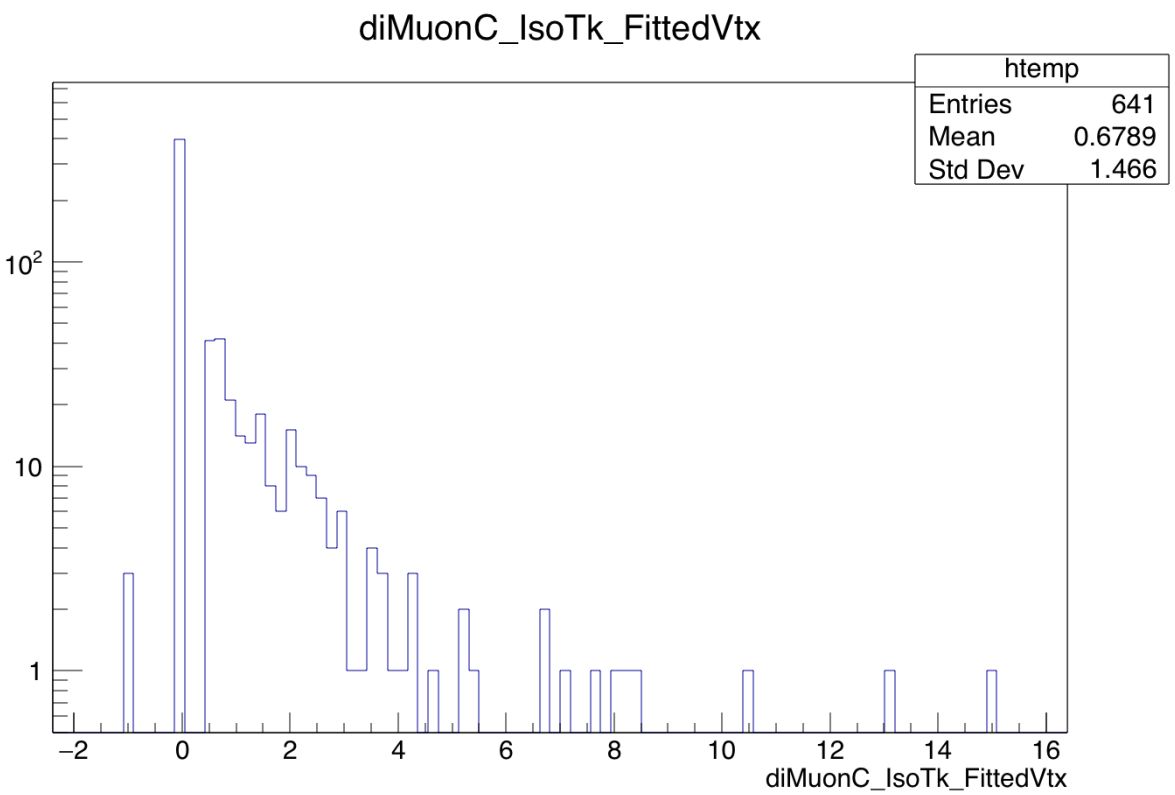

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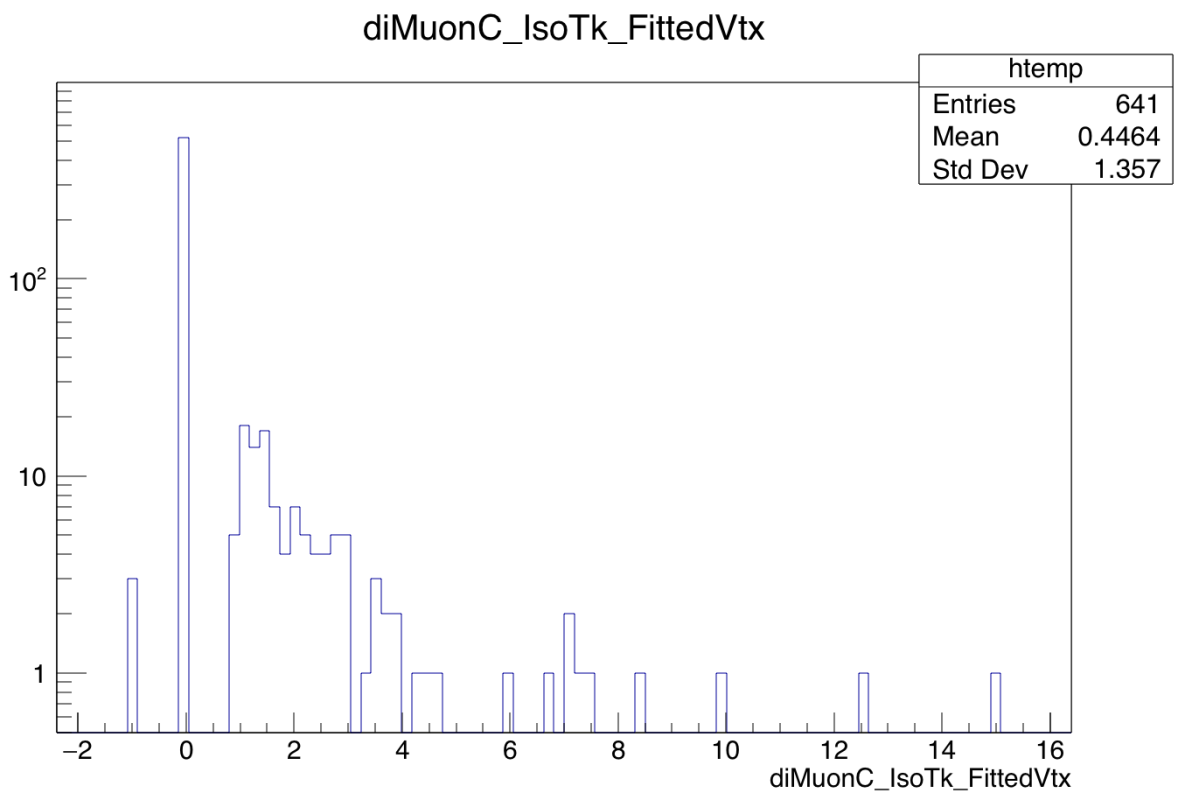

SameTrack 0.8

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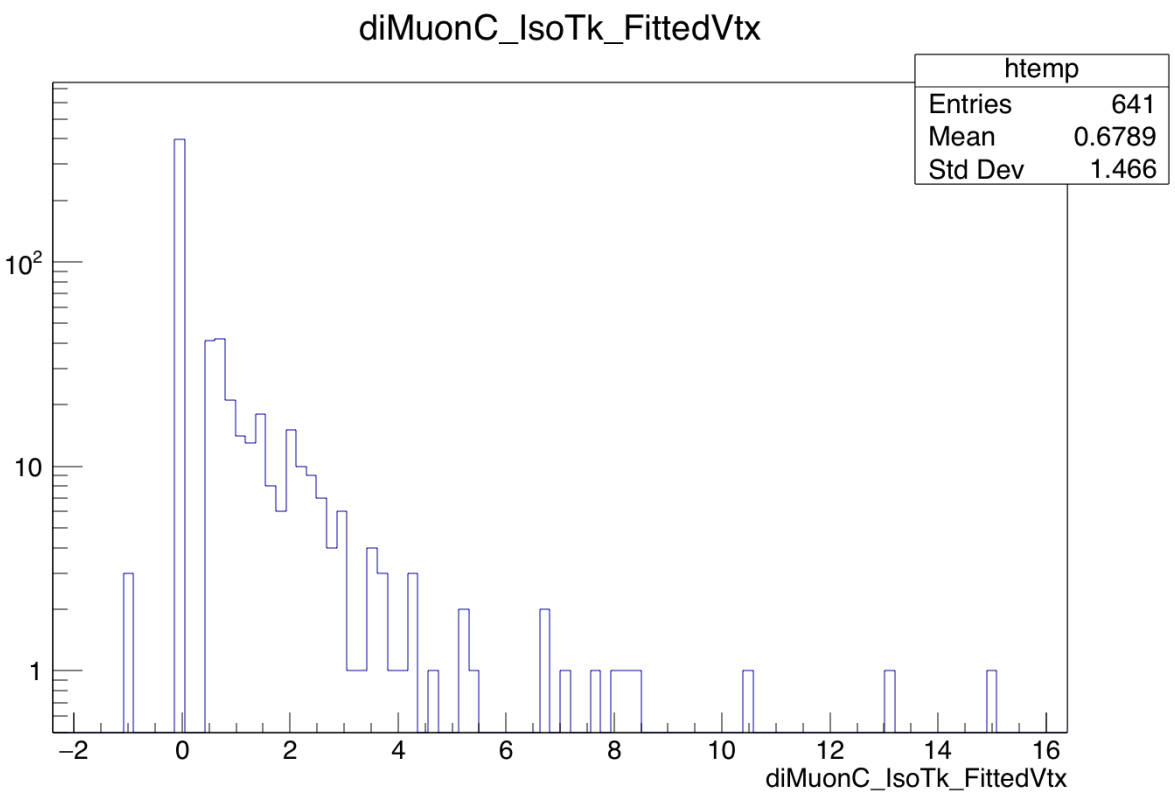

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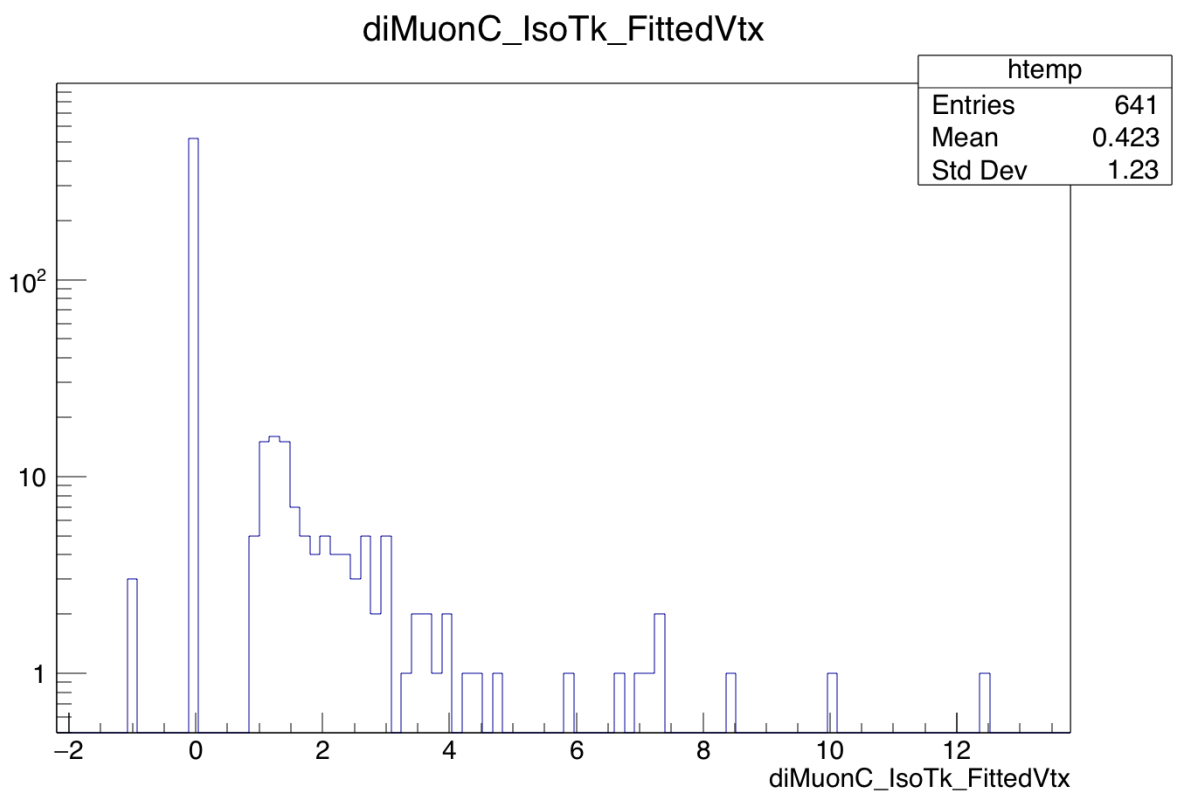

SameTrack 0.9

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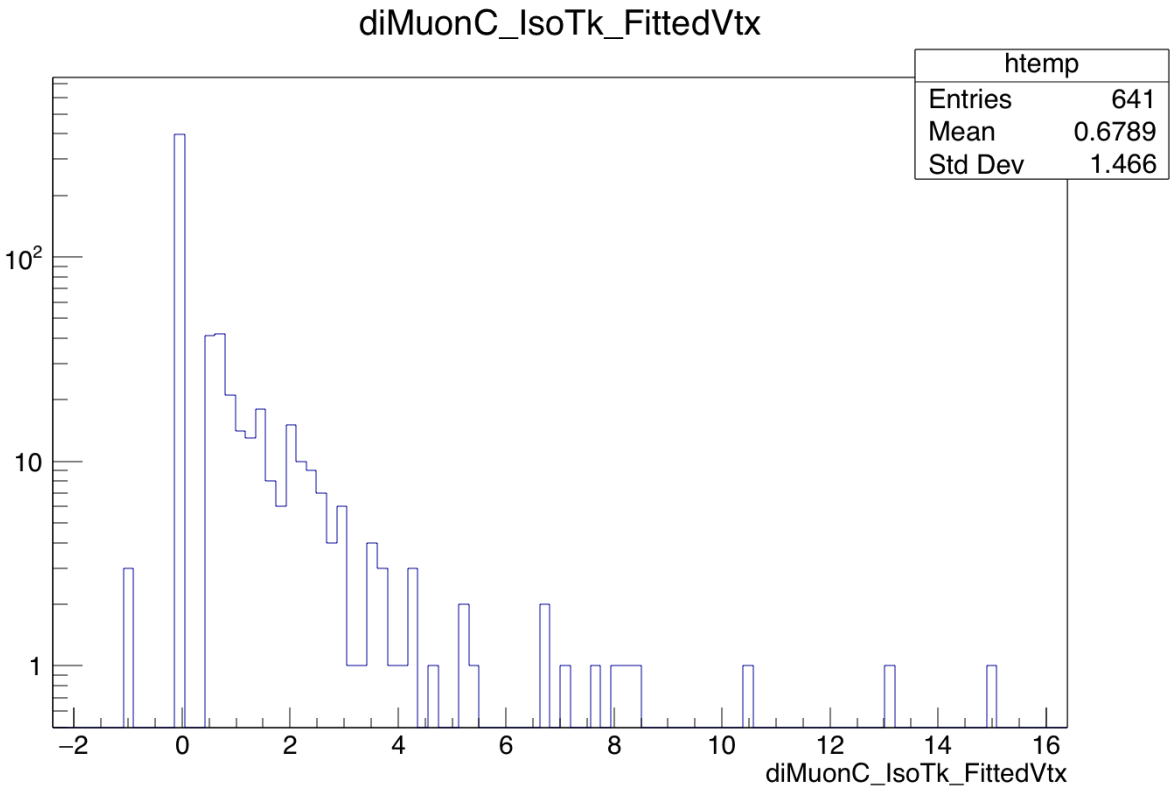

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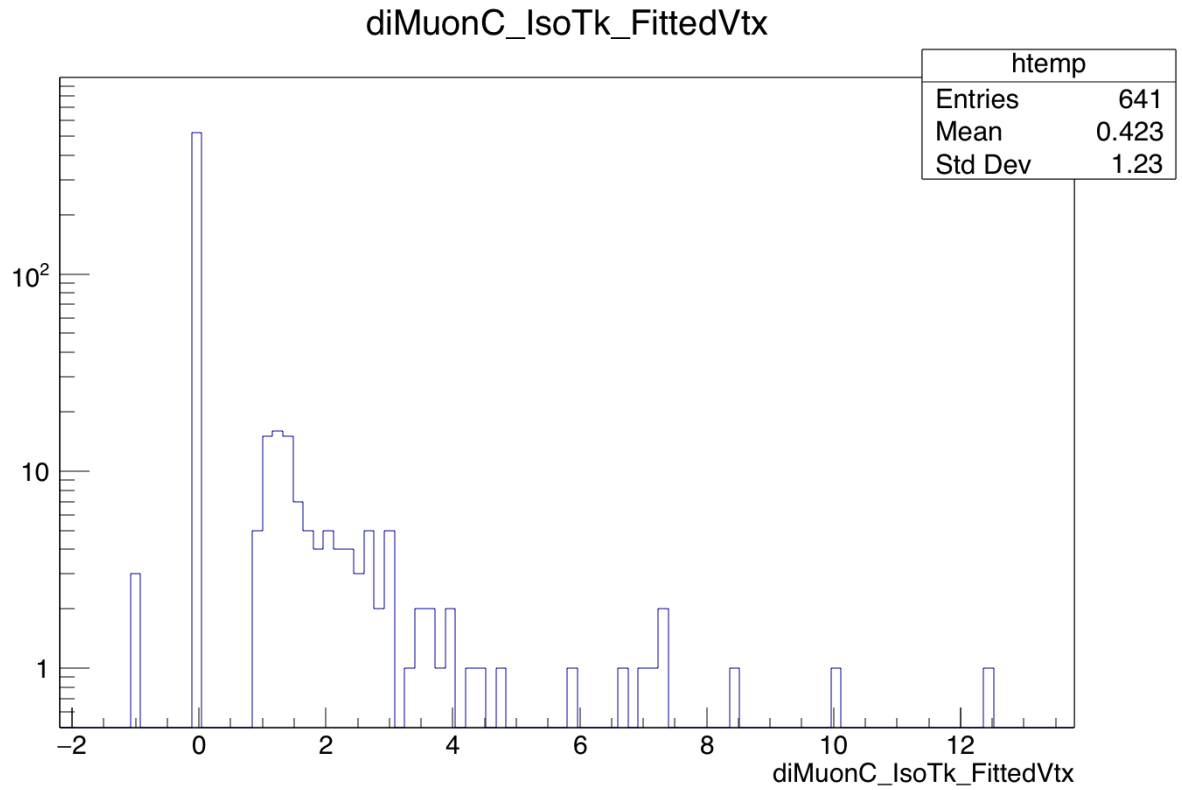

SameTrack 1.0

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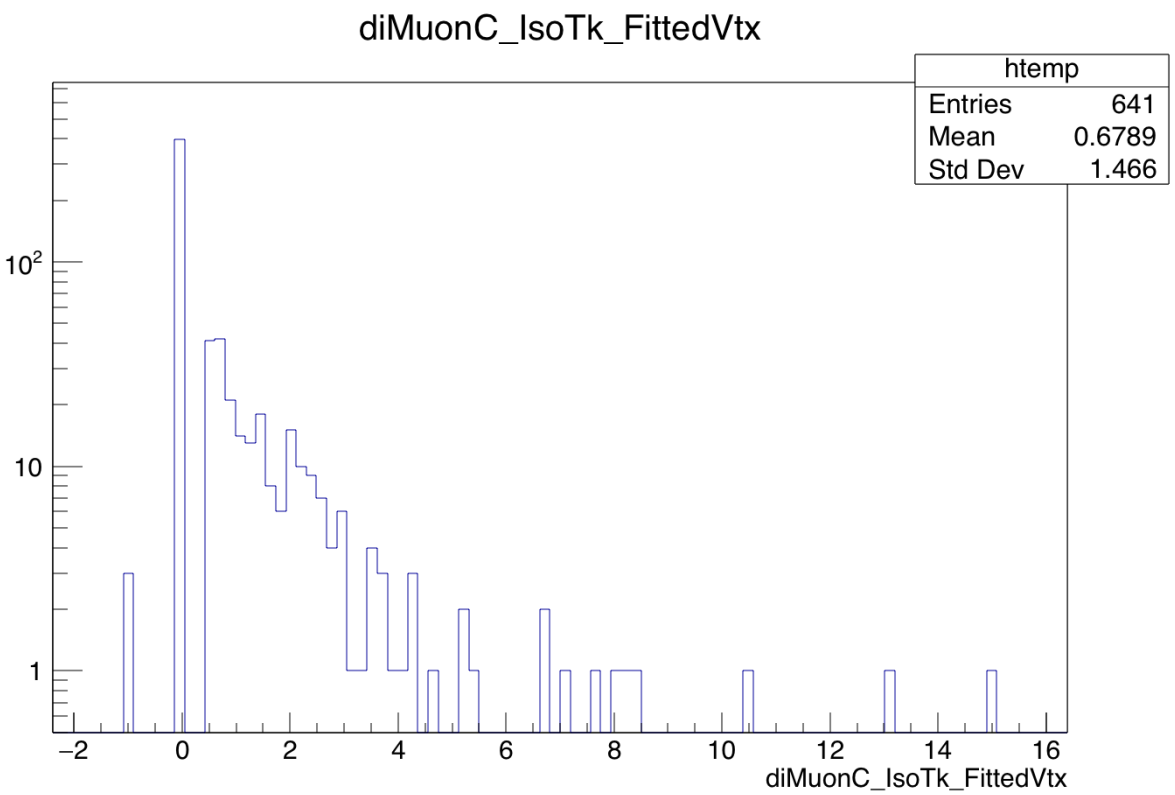

MiniAOD