Migrate to MiniAOD
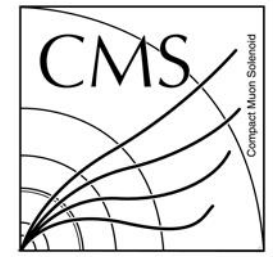
Wei Shi

TAMU+RICE working meeting

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 or find other track matching method
- "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
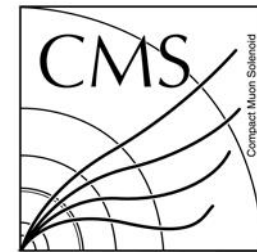
BACK UP

isDiMuonHLTFired
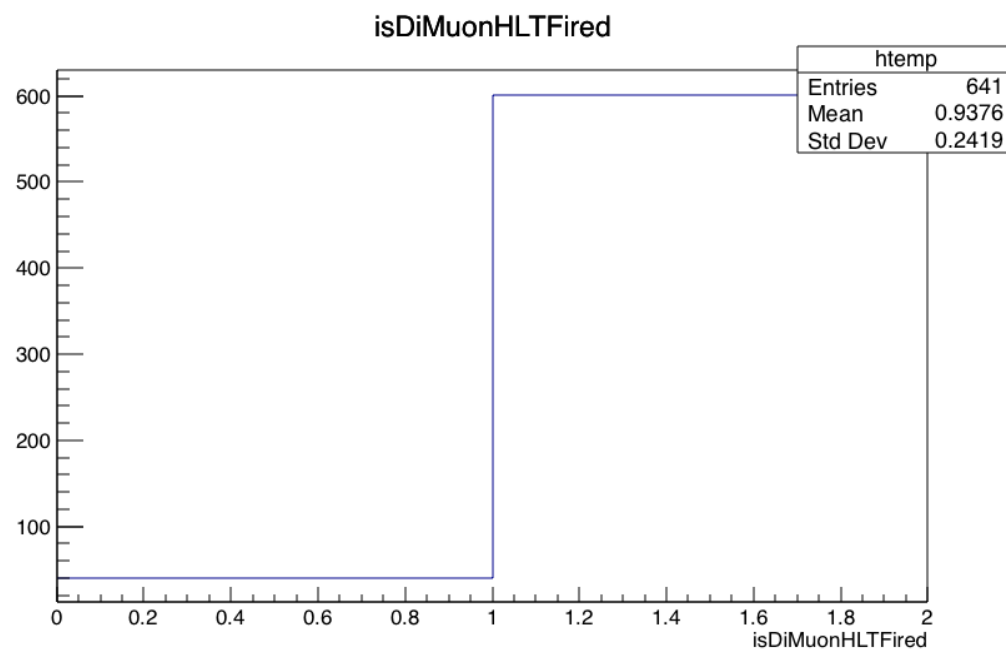
AOD
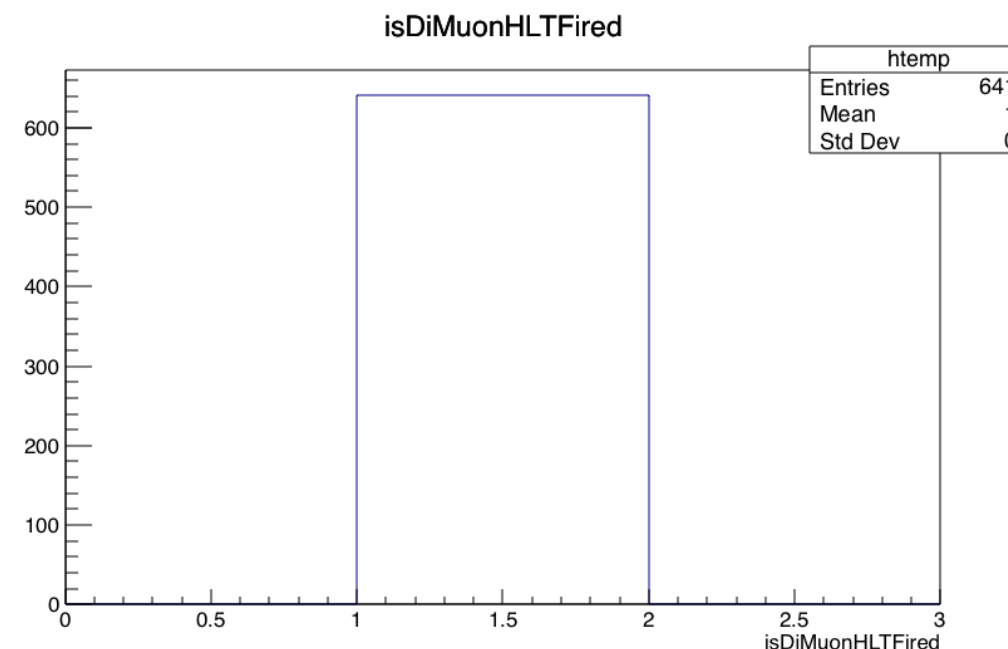
MiniAOD

- In MiniAOD, the signal HLT path "HLT_TrkMu15_DoubleTrkMu5NoFiltersNoVtx_v3" is fired in every single event, this is not right

Solution

```
for (auto p : allMuHltPaths_){
  if ( triggerEvent->path(p)->wasAccept() ) { //the path "p" is checked in AOD
    b_hltPaths.push_back(p);
    if(std::find(signalHltPaths_.begin(), signalHltPaths_.end(), p) != signalHltPaths_.end()) {
      b_isDiMuonHLTFired = true;
    }
  }                                                              AOD
}
```
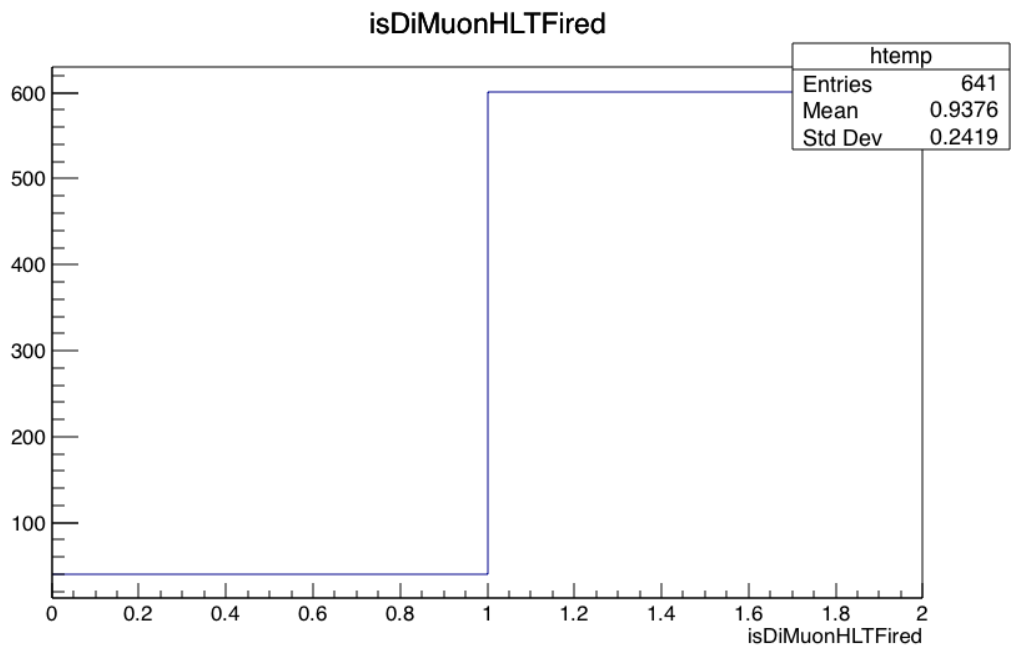
if(trRes->accept(itrg)){ //similar to AOD, add this to check if the event passed the trigger bit "itrig" in the HLT menu
b_hltPaths.push_back(trigNameStr);
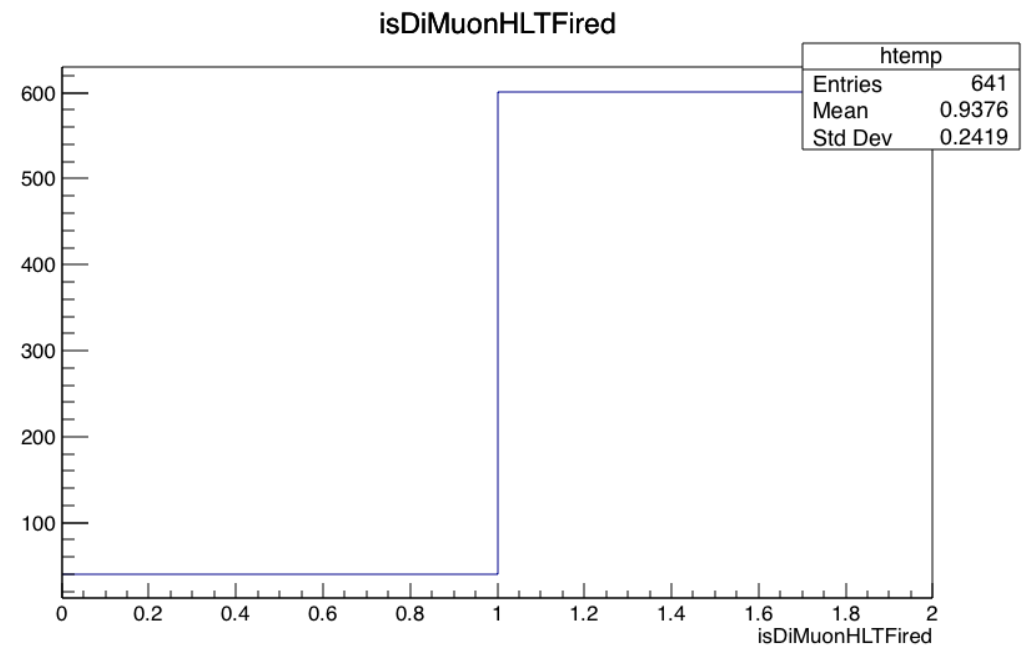
```
  if(std::find(signalHltPaths_.begin(), signalHltPaths_.end(), trigNameStr) !=    signalHltPaths_.end()) {
    b_isDiMuonHLTFired = true;
  }
}                                                              MiniAOD
```
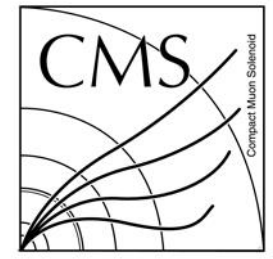
isDiMuonHLTFired

AOD

MiniAOD

Hit pattern of muons in dimuon

- Due to tamu::helpers::sameTrack function precision
  - We use this function to determine whether a track is the muon track used in dimuon, affect all kind of isolation(dimuon, muon orphan etc) as reported before
  - Will affect all hit pattern branches, e.g.
    - b_diMuonC_m1_FittedVtx_HBV
    - b_diMuonC_m1_FittedVtx_MHAV
    - b_diMuonC_m1_FittedVtx_hitpix
    - b_diMuonC_m1_FittedVtx_hitpix_l2inc
    - b_diMuonC_m1_FittedVtx_hitpix_l3inc
  - Code reference: https://github.com/weishi10141993/MuJetAnalysis/blob/for-CMSSW-80X-NoPHR-RAWAODSIM/CutFlowAnalyzer/plugins/CutFlowAnalyzer_MiniAOD.cc#L2097-L2149

An example
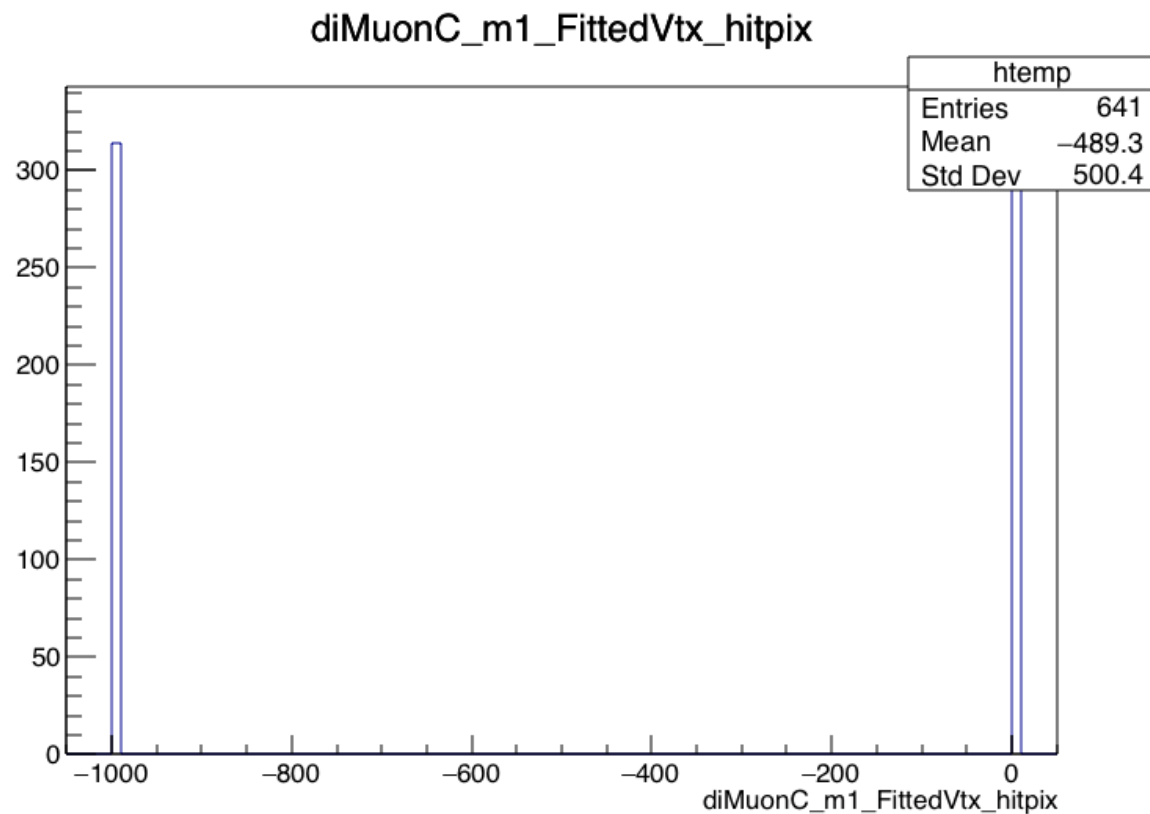
AOD
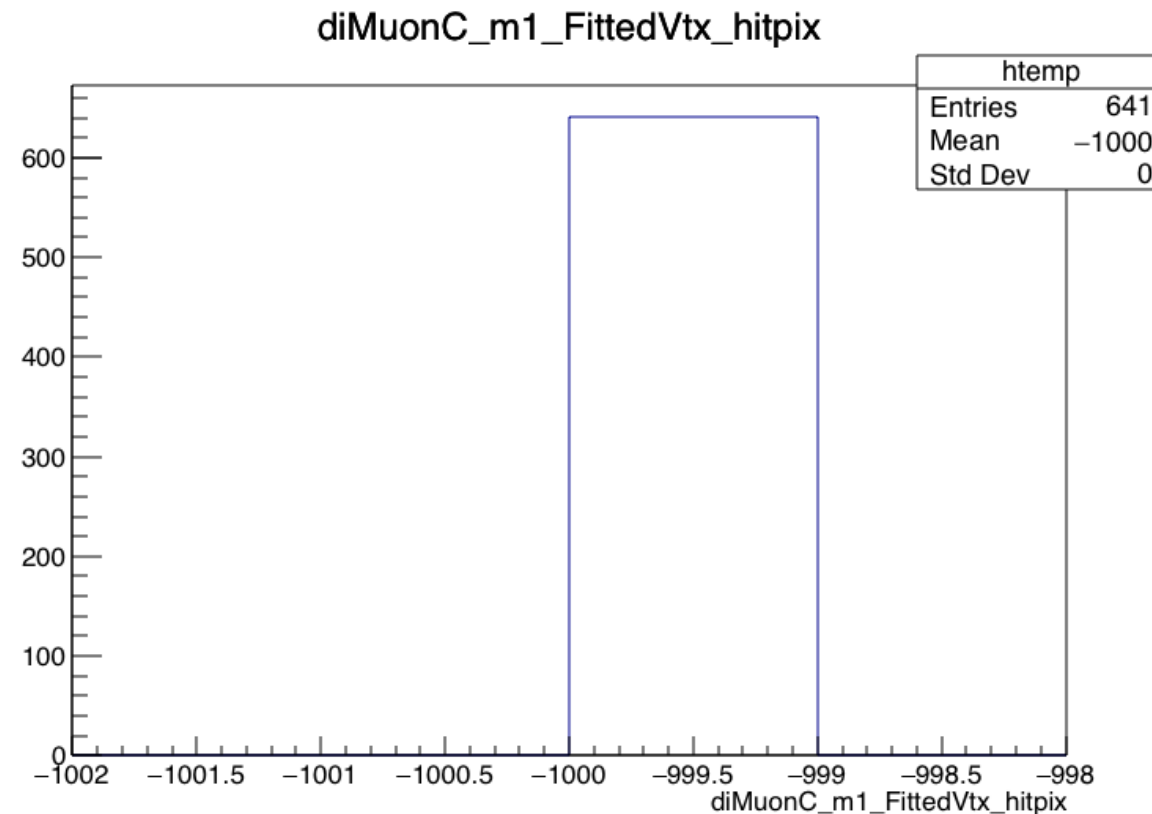
MiniAOD

- Check muon in dimuons has valid hit in first pixel layer in barrel or endcap

isVertexOK

- if (vertex->isValid() && !vertex->isFake() && vertex->tracksSize() >= 4 && fabs(vertex->z()) < 24.)
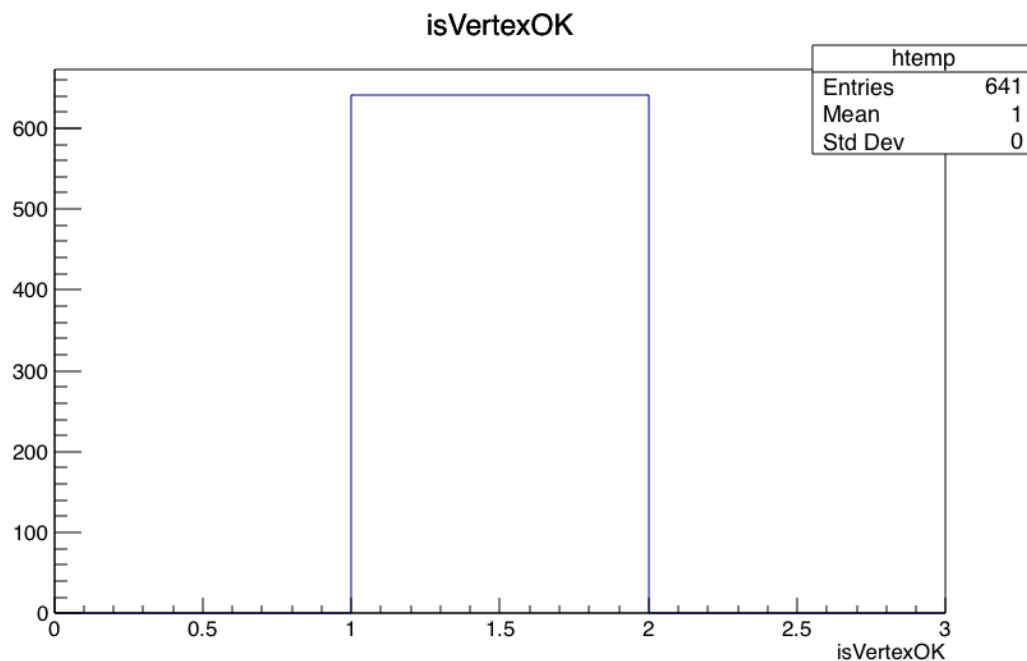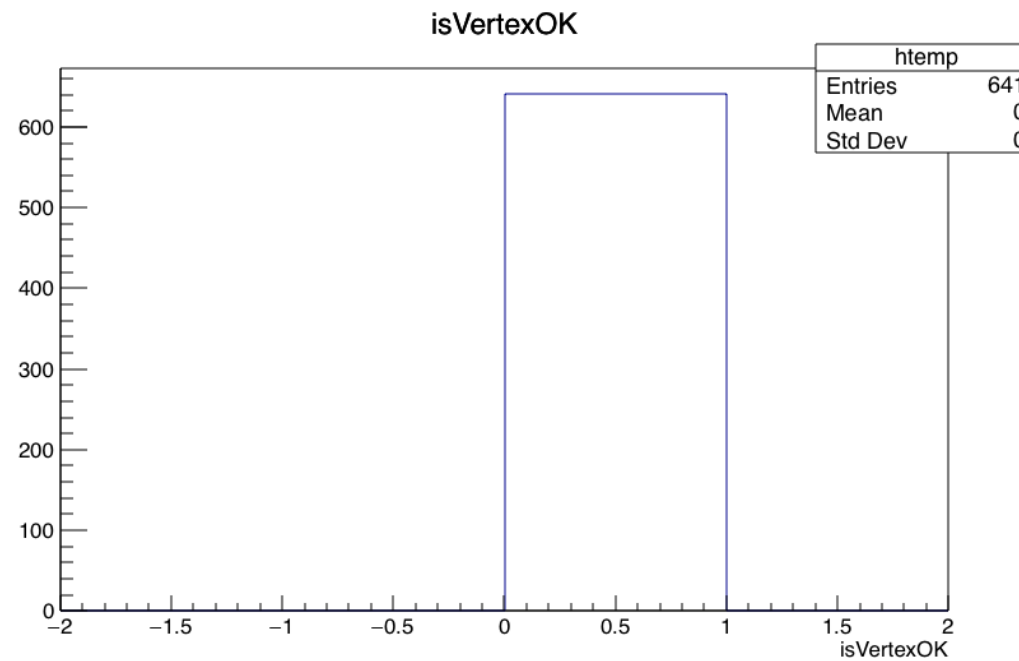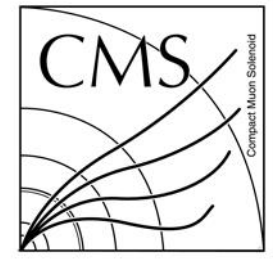

AOD

MiniAOD

- Determine if 2 dimuons has a valid vertex

AOD vs MiniAOD #100

- AOD

- primary vertices size: 30

- @ 1 vertex valid: 1, vertex fake: 0, vertex trk size: 62, vertex z: 3.28194

- >>> vertex ok

- @ 2 vertex valid: 1, vertex fake: 0, vertex trk size: 6, vertex z: 2.86545

- >>> vertex ok

- MiniAOD

- primary vertices size: 30

- @ 1 vertex valid: 1, vertex fake: 0, vertex trk size: 0, vertex z: 3.28194

- @ 2 vertex valid: 1, vertex fake: 0, vertex trk size: 0, vertex z: 2.86545

- MiniAOD vertices don't contain track references, but the association of candidates to vertices is provided in the packed candidates

- Reference: https://twiki.cern.ch/twiki/bin/view/CMSPublic/WorkBookMiniAOD2016#Primary_vertices_and_BeamSpot

b_diMuonC_FittedVtx_Lxy_rclstvtx

if (vertex->isValid() && !vertex->isFake() && vertex->tracksSize() > 3 && fabs(vertex->z()) < 24.)
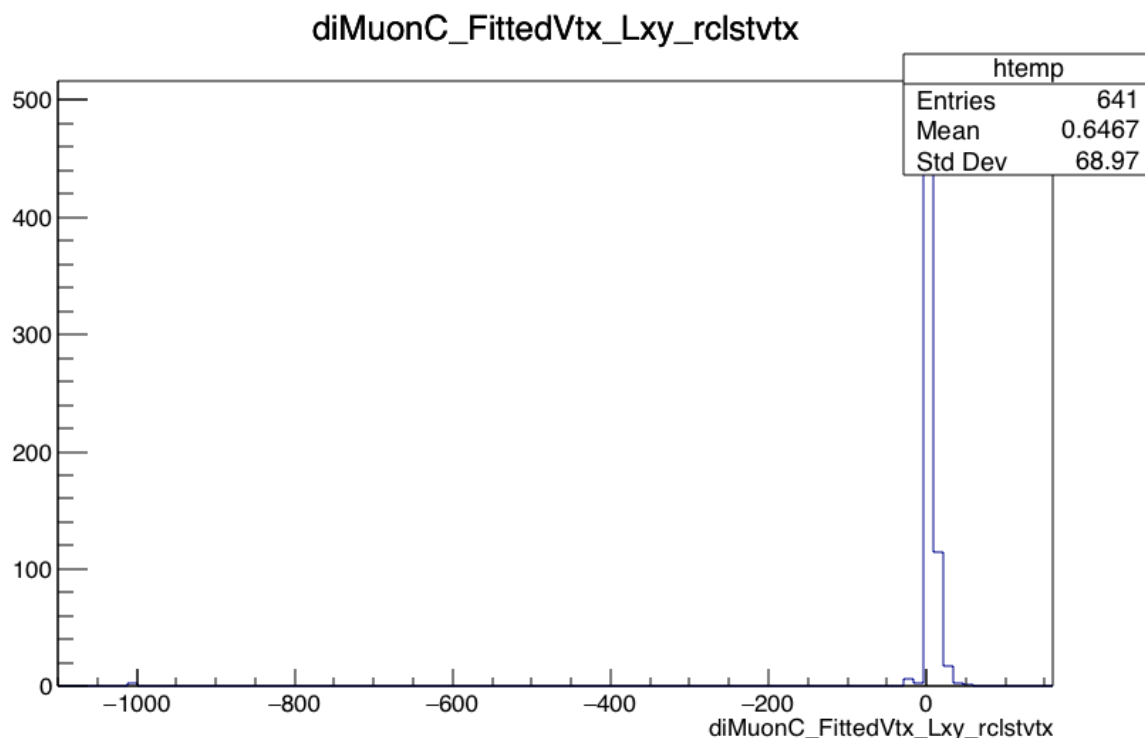
AOD
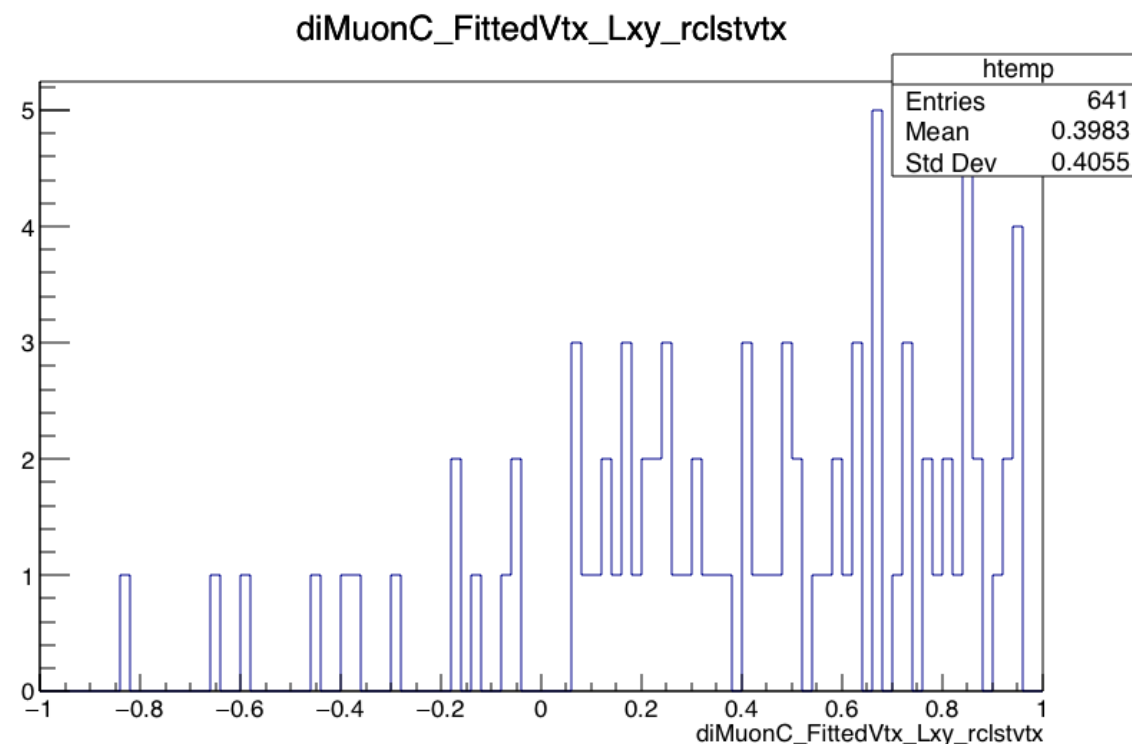
MiniAOD

- closestPrimaryVertex is used for branches *_FittedVtx_Lxy_rclstvtx
- MiniAOD overflow ~500 at 1, underflow

Solution to vertex-track association

- Change primaryVertices = cms.InputTag("offlineSlimmedPrimaryVertices") to primaryVertices = cms.InputTag("unpackedTracksAndVertices") in CutFlowAnalyzer_MiniAOD_cfi.py

- Reference: https://github.com/weishi10141993/MuJetAnalysis/blob/for-CMSSW-80X-NoPHR-RAWAODSIM/CutFlowAnalyzer/python/CutFlowAnalyzer_MiniAOD_cfi.py#L17

Printout info

- AOD

primary vertices size: 30

@ 1 vertex valid: 1, vertex fake: 0, vertex trk size: 62, vertex z: 3.28194

>>> vertex ok

@ 2 vertex valid: 1, vertex fake: 0, vertex trk size: 6, vertex z: 2.86545

>>> vertex ok

- MiniAOD

primary vertices size: 30

@ 1 vertex valid: 1, vertex fake: 0, vertex trk size: 21, vertex z: 3.28194

>>> vertex ok

@ 2 vertex valid: 1, vertex fake: 0, vertex trk size: 0, vertex z: 2.86545

- Vertex now has reference to tracks, still have discrepancy in trk size, recall in the isolation problem we found AOD do store more low pT tracks(<0.5 GeV) than MiniAOD

isVertexOK

- if (vertex->isValid() && !vertex->isFake() && vertex->tracksSize() >= 4 && fabs(vertex->z()) < 24.)

AOD
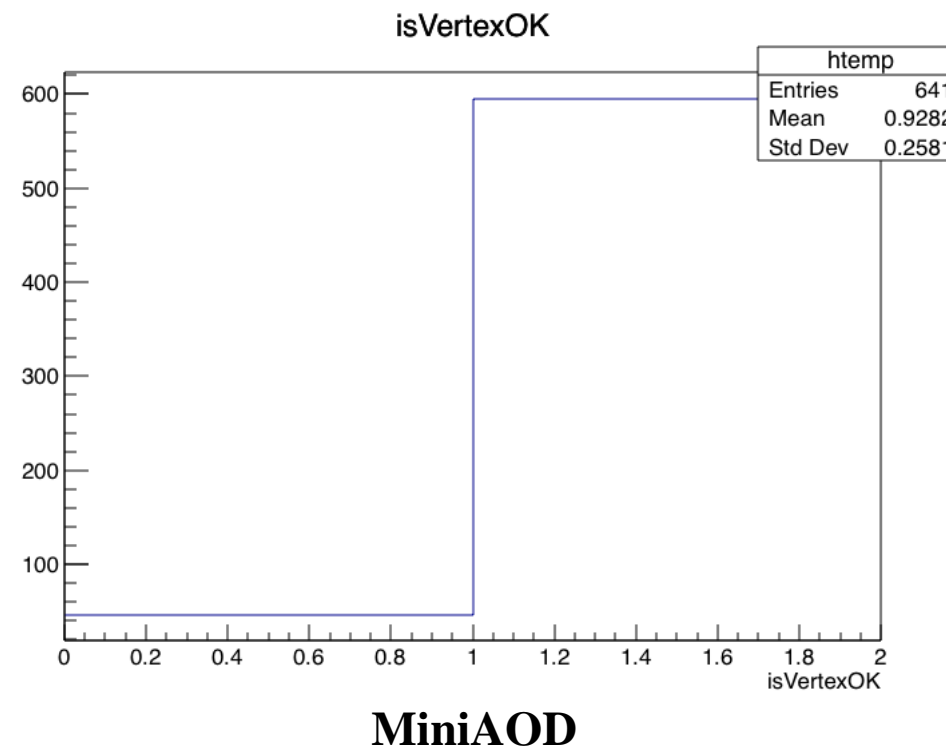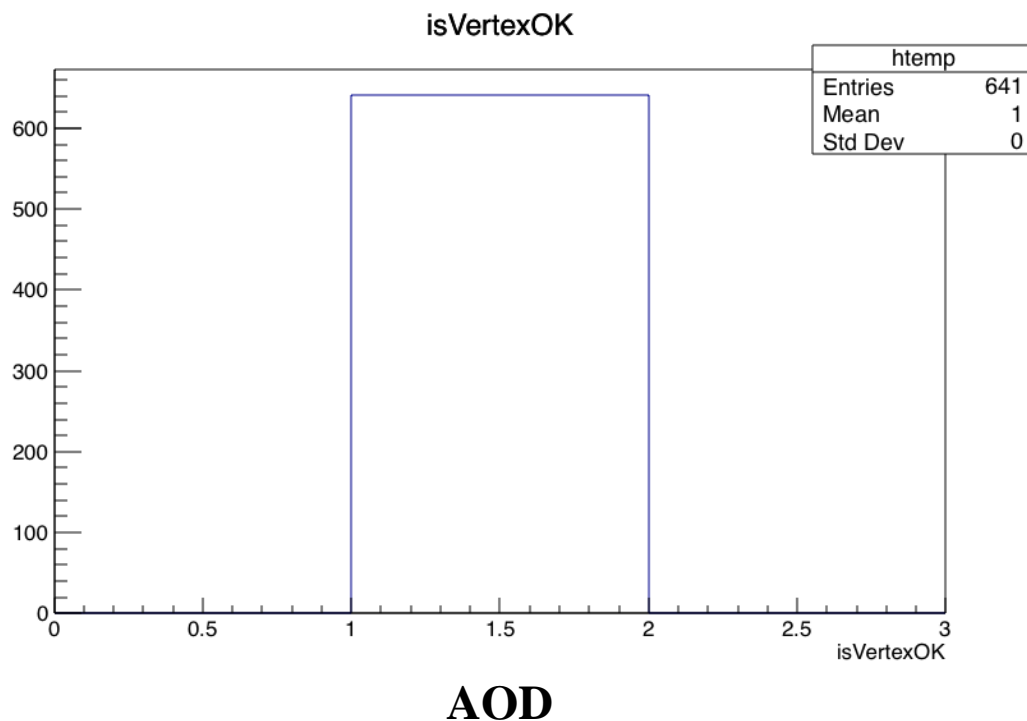
MiniAOD

- Since AOD store more low pT tracks, it make sense many vertex satisfy the tracksSize >3, thus more events pass

b_diMuonC_FittedVtx_Lxy_rclstvtx

if (vertex->isValid() && !vertex->isFake() && vertex->tracksSize() > 3 && fabs(vertex->z()) < 24.)
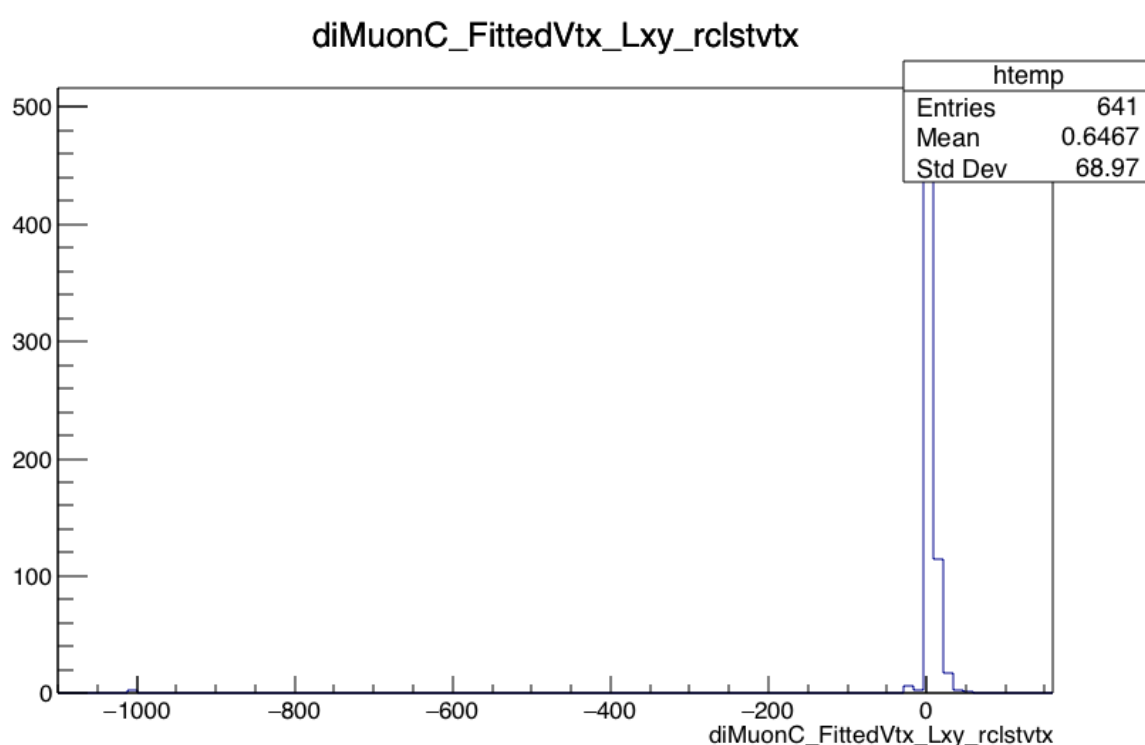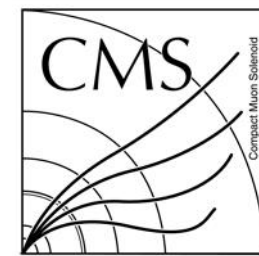
AOD
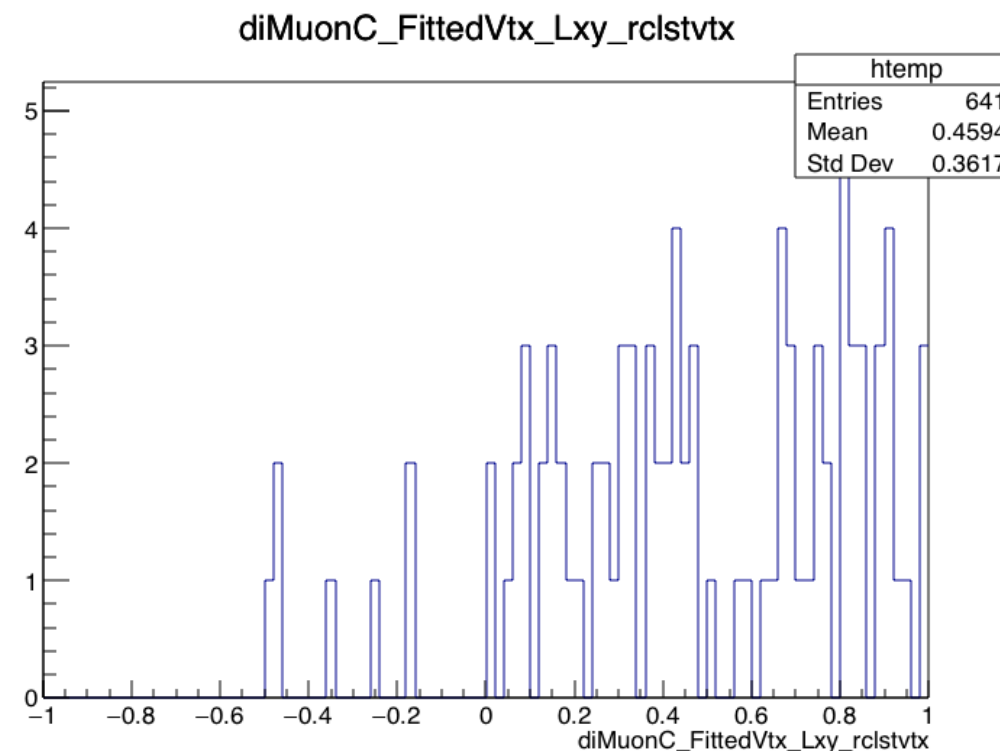
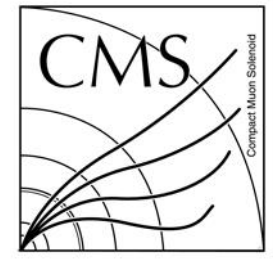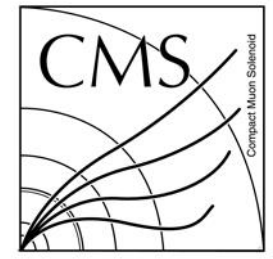

MiniAOD

- MiniAOD still has overflow/under fow at 1/-1

Trigger info debug: AOD

- HLT cut #94 use PatTriggerEvent
  - Not fired in every event, not fired in #90 where two dimuon is identified

Input trigger results size: 3 (RECO)
- @ 0 trigName: raw2digi_step trigNameStr: raw2digi_step
- @ 1 trigName: L1Reco_step trigNameStr: L1Reco_step
- @ 2 trigName: reconstruction_step trigNameStr: reconstruction_step

PATTriggerEvent
- @ HLT_TrkMu15_DoubleTrkMu5NoFiltersNoVtx_v3 in patTriggerEvent!
- >>> Accepted <<<
- *** Fired ***
- @ HLT_TrkMu17_DoubleTrkMu8NoFiltersNoVtx_v3 in patTriggerEvent!
- >>> Accepted <<<
- @ HLT_DoubleMu18NoFiltersNoVtx_v3 in patTriggerEvent!
- >>> Accepted <<<
- @ HLT_DoubleMu23NoFiltersNoVtxDisplaced_v3 in patTriggerEvent!
- @ HLT_DoubleMu28NoFiltersNoVtxDisplaced_v3 in patTriggerEvent!

NOTE:

AOD with TriggerResults HLT also has size 595 and "HLT_TrkMu15_DoubleTrkMu5NoFiltersNoVtx_v3" is fired at 450th , same as miniAOD, and is found as signal path in each event

Trigger info debug: MiniAOD

- HLT cut #94 use TriggerResults
  - "HLT_TrkMu15_DoubleTrkMu5NoFiltersNoVtx_v3" fired in each event
- Input trigger results size: 595 (HLT)
- @ 0 trigName: digitisation_step trigNameStr: digitisation_step
- @ 1 trigName: L1simulation_step trigNameStr: L1simulation_step
- @ 2 trigName: digi2raw_step trigNameStr: digi2raw_step
- @ 3 trigName: HLTriggerFirstPath trigNameStr: HLTriggerFirstPath
- @ 4 trigName: HLT_AK8PFJet360_TrimMass30_v4 trigNameStr: HLT_AK8PFJet360_TrimMass30_v4
- @ 5 trigName: HLT_AK8PFHT700_TrimR0p1PT0p03Mass50_v4 trigNameStr: HLT_AK8PFHT700_TrimR0p1PT0p03Mass50_v4
- @ 450 trigName: HLT_TrkMu15_DoubleTrkMu5NoFiltersNoVtx_v3 trigNameStr: HLT_TrkMu15_DoubleTrkMu5NoFiltersNoVtx_v3
- >>> trigNameStr is fired!
- @ 451 trigName: HLT_TrkMu17_DoubleTrkMu8NoFiltersNoVtx_v3 trigNameStr: HLT_TrkMu17_DoubleTrkMu8NoFiltersNoVtx_v3
- @ 452 trigName: HLT_Mu8_v4 trigNameStr: HLT_Mu8_v4
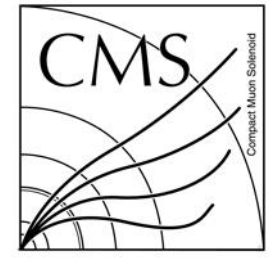
Same GEN Info

- Same Cut flow table
  - 10000 events
  - Same number of events with 4 GEN muons after each selection step

GEN info: 2016 DarkSUSY AOD

```
********** GEN **********
Selection                nEv            RelEff       Eff
pT1>17 |eta1|<0.9:      3371 0.3371     0.3371
pT2>8  |eta2|<2.4:      3084 0.914862                0.3084
pT3>8  |eta2|<2.4:      2039 0.661154                0.2039
pT4>8  |eta2|<2.4:      945  0.463462                0.0945
Basic MC Acceptance:    0.0945
```

```
********** RECO **********
Selection                nEv            RelEff       Eff
m_events1SelMu17:       3323            0.3323     0.3323
m_events2SelMu8:        2969            0.89347    0.2969
m_events3SelMu8:        1907            0.642304
                         0.1907
m_events4SelMu8:        789  0.413739                0.0789
Basic Acceptance:                0.0789
Basic MC Accept. a_gen:  0.0945
m_events2MuJets:        643  0.814956                0.0643
m_events2DiMuons:       641             0.99689    0.0641
```

GEN info: 2016 DarkSUSY MiniAOD

```
********** GEN **********
Selection              nEv        RelEff      Eff
pT1>17 |eta1|<0.9:    3371 0.3371    0.3371
pT2>8  |eta2|<2.4:    3084 0.914862           0.3084
pT3>8  |eta2|<2.4:    2039 0.661154           0.2039
pT4>8  |eta2|<2.4:     945 0.463462           0.0945
Basic MC Acceptance:    0.0945
```

```
********** RECO **********
Selection              nEv        RelEff    Eff
m_events1SelMu17:     3323        0.3323    0.3323
m_events2SelMu8:      2969        0.89347 0.2969
m_events3SelMu8:      1907        0.642304
                      0.1907
m_events4SelMu8:       789 0.413739           0.0789
Basic Acceptance:          0.0789
Basic MC Accept. a_gen: 0.0945
m_events2MuJets:       643 0.814956           0.0643
m_events2DiMuons:      641           0.99689 0.0641
```

Conclusion

- GEN info between MiniAOD and AOD is same
  - Same GEN dark photon position and momentum distribution
  - Same GEN final state muon position and momentum distribution
  - /afs/cern.ch/work/w/wshi/public/MiniAODMC/out_ana_MiniAODMC.root
  - /afs/cern.ch/work/w/wshi/public/AODMC/out_ana_AODMC.root

GEN info: 2016 DarkSUSY AOD

```
********** GEN **********

Selection          nEv          RelEff   Eff

pT1>17 |eta1|<0.9:    37      0.37      0.37

pT2>8  |eta2|<2.4:    32      0.864865 0.32

pT3>8  |eta2|<2.4:    21      0.65625  0.21

pT4>8  |eta2|<2.4:     7      0.333333 0.07

Basic MC Acceptance:      0.07
```
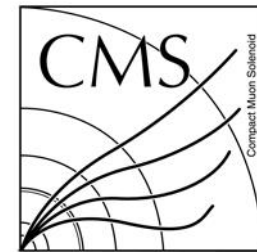
```
********** RECO **********
Selection              nEv          RelEff     Eff
m_events1SelMu17:      37   0.37          0.37
m_events2SelMu8:       31   0.837838          0.31
m_events3SelMu8:       19   0.612903          0.19
m_events4SelMu8:        7   0.368421          0.07
Basic Acceptance:          0.07
Basic MC Accept. a_gen:  0.07
m_events2MuJets:        4   0.571429          0.04
m_events2DiMuons:       4   1          0.04
```
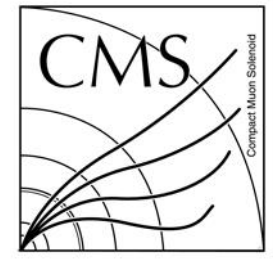
GEN info: 2016 DarkSUSY MiniAOD

- ********** GEN **********
- Selection   nEv   RelEff   Eff
- pT1>17 |eta1|<0.9:   37   0.37   0.37
- pT2>8 |eta2|<2.4:   32   0.864865 0.32
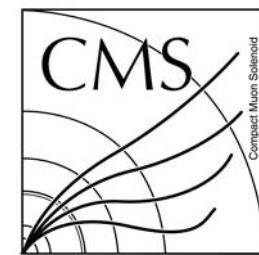- pT3>8 |eta2|<2.4:   21   0.65625 0.21
- pT4>8 |eta2|<2.4:   7   0.333333 0.07
- Basic MC Acceptance: 0.07

********** RECO **********

Selection	nEv	RelEff	Eff
m_events1SelMu17:	37	0.37	0.37
m_events2SelMu8:	31	0.837838	0.31
m_events3SelMu8:	19	0.612903	0.19
m_events4SelMu8:	7	0.368421	0.07
Basic Acceptance:	0.07		
Basic MC Accept. a_gen:	0.07		
m_events2MuJets:	4	0.571429	0.04
m_events2DiMuons:	4	1	0.04

GEN info: 2017 DarkSUSY AOD

```
********** GEN **********

Selection          nEv          RelEff     Eff

pT1>17 |eta1|<0.9:   41           0.41       0.41

pT2>8  |eta2|<2.4:   41           1          0.41

pT3>8  |eta2|<2.4:   31           0.756098   0.31

pT4>8  |eta2|<2.4:   15           0.483871   0.15

Basic MC Acceptance:      0.15
```

```
********** RECO **********
Selection          nEv          RelEff     Eff
m_events1SelMu17:       42   0.42          0.42
m_events2SelMu8:        41   0.97619       0.41
m_events3SelMu8:        30   0.731707             0.3
m_events4SelMu8:        15   0.5           0.15
Basic Acceptance:        0.15
Basic MC Accept. a_gen:  0.15
m_events2MuJets:        13   0.866667             0.13
m_events2DiMuons:       12   0.923077             0.12
```

GEN info: 2017 DarkSUSY MiniAOD

```
********** GEN **********

Selection          nEv          RelEff    Eff

pT1>17 |eta1|<0.9:    41       0.41      0.41

pT2>8  |eta2|<2.4:    41       1         0.41

pT3>8  |eta2|<2.4:    31       0.756098  0.31

pT4>8  |eta2|<2.4:    15       0.483871  0.15

Basic MC Acceptance:      0.15
```
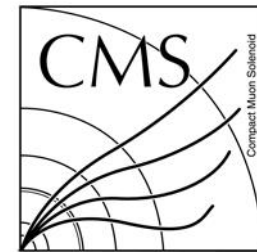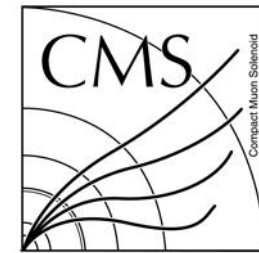
```
********** RECO **********

Selection              nEv        RelEff     Eff
m_events1SelMu17:      42    0.42         0.42
m_events2SelMu8:       41    0.97619      0.41
m_events3SelMu8:       30    0.731707         0.3
m_events4SelMu8:       15    0.5          0.15
Basic Acceptance:           0.15
Basic MC Accept. a_gen:  0.15
m_events2MuJets:       13    0.866667         0.13
m_events2DiMuons:      12    0.923077         0.12
```

Isolation dimuonC: AOD vs MiniAOD

AOD
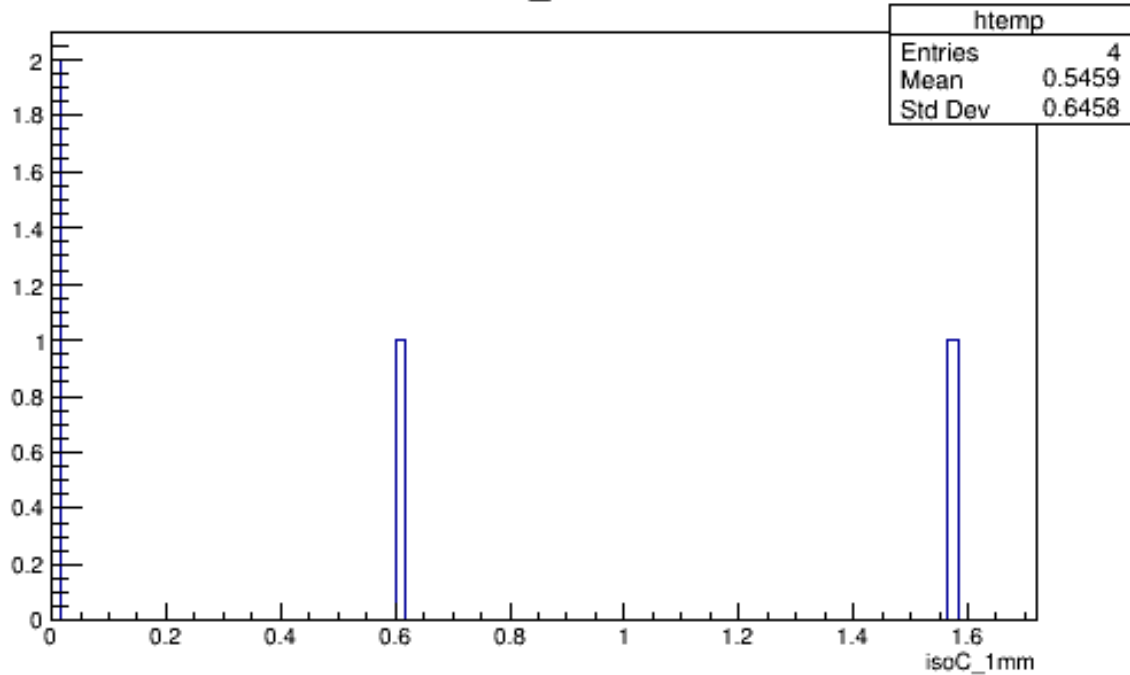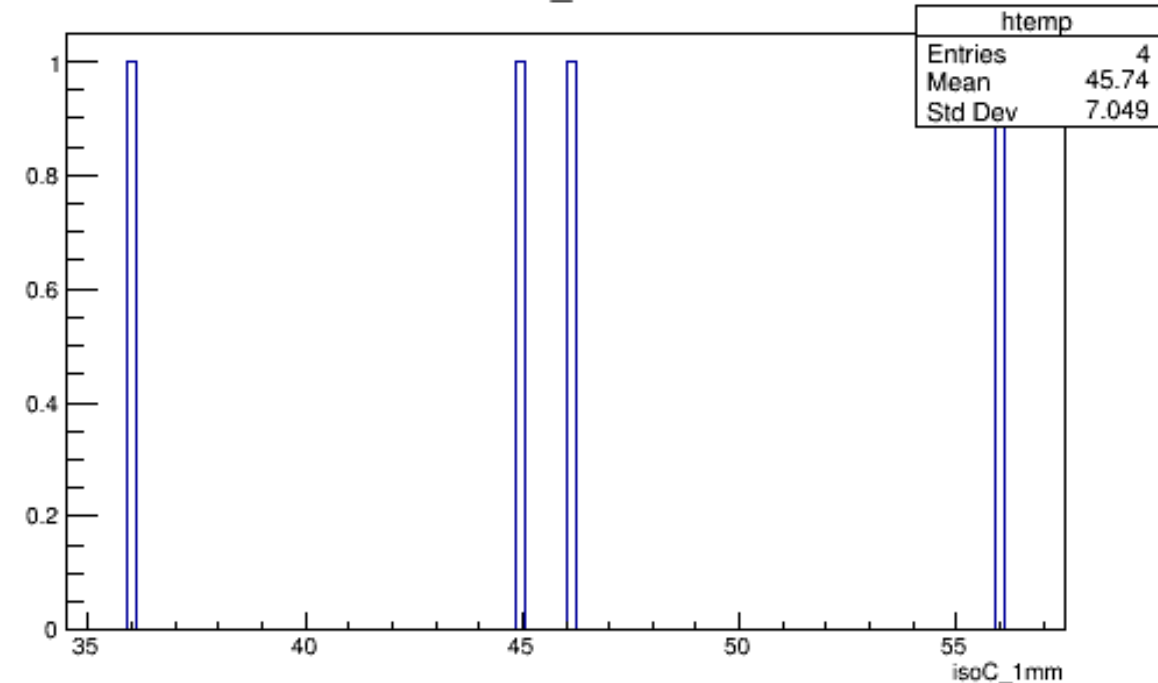
MiniAOD

- Use a private DarkSUSY MC sample 100 events, mass=0.4GeV, ct=0.5mm
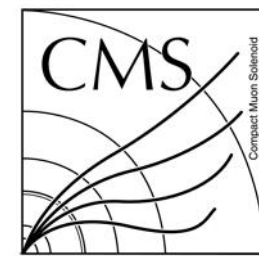
Quick answers to questions (by Luca)

- Are the dimuons the same? Are the tracks the only difference?
  - Both yes

- Is the cone built around the dimuon the same?
  - All tracks used in isolation satisfy the cone definition ($dz < 0.1$ cm, $dR < 0.4$, $pT > 0.5$ GeV)
  - MiniAOD is fail to identify the muon track used in dimuons (reduced precision)

- If so: is the number of tracks different, or the pT or both? Who has more tracks or tracks with higher pT?
  - AOD has hundreds more tracks under 2GeV, miniAOD has no tracks below 0.5GeV

- In miniAOD how many track collections are there? maybe should I use a different collection?
  - Currently used collection is suggested by Hypernews experts
  - So far not very clear about missed tracks belong to which collection (will ask on Hypernews)

- Is one a subset of the other?
  - I would say MiniAOD tracks are possibly a subset of AOD tracks

An example
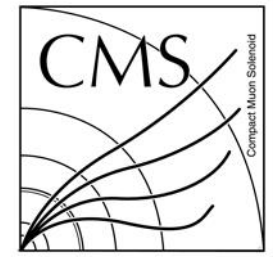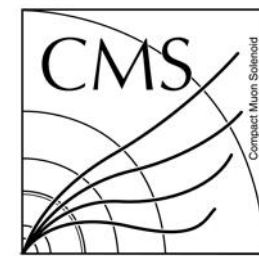
- *** Number of tracks 377
- @@@ i = 1
- diMuon 1: vertex x   1.61897: vertex y   1.19394: vertex z   -5.59037
-      vertex phi 0.590605; vertex eta 0.26232; vertex dz -5.00217
-      vertex px 37.0668: vertex py 24.8508: vertex pz 11.8411
-      muon_0 px 25.022; muon_0 py 16.9382; muon_0 pz 8.03981; muon_0 pt 30.2159
-      muon_0 vx 0.105029; muon_0 vy 0.168395; muon_0 vz -6.07878
-      muon_1 px 12.0451; muon_1 py 7.91272; muon_1 pz 3.80127; muon_1 pt 14.4117
-      muon_1 vx 0.090093; muon_1 vy 0.191123; muon_1 vz -6.07021
- ### Satisfy isolation requirement ###
- @@@ track number: 63
- track phi 0.579156; track eta 0.0877341; track z -5.0172
- track pt   1.5798; dR   0.174961; Iso_dz   0.0150237; diMuonTmp_Iso   1.5798
- @@@ track number: 65
- >>> This track is used in dimuon <<<
- track px 25.022; track py 16.9382; track pz 8.03981; track pt 30.2159
- track vx 0.105029; track vy 0.168395; track vz -6.07878
- @@@ track number: 377
- >>> This track is used in dimuon <<<
- track px 12.0451; track py 7.91272; track pz 3.80127; track pt 14.4117
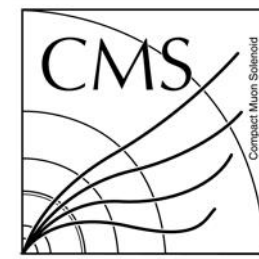- track vx 0.090093; track vy 0.191123; track vz -6.07021

Print out MiniAOD #9

- *** Number of tracks 87
- @@@ i = 1
- diMuon 1: vertex x   1.61897: vertex y   1.19394: vertex z   -5.59037
-     vertex phi 0.590605; vertex eta 0.26232; vertex dz -5.00217
-     vertex px 37.0668: vertex py 24.8508: vertex pz 11.8411
-     muon_0 px 25.022; muon_0 py 16.9382; muon_0 pz 8.03981; muon_0 pt 30.2159
-     muon_0 vx 0.105029; muon_0 vy 0.168395; muon_0 vz -6.07878
-     muon_1 px 12.0451; muon_1 py 7.91272; muon_1 pz 3.80127; muon_1 pt 14.4117
-     muon_1 vx 0.090093; muon_1 vy 0.191123; muon_1 vz -6.07021
- ### Satisfy isolation requirement ###
- @@@ track number: 15
- track phi 0.595038; track eta 0.262947; track z -5.0054
- track pt 30.2187; dR   0.00447746; Iso_dz 0.00322276; diMuonTmp_Iso 30.2187
- ### Satisfy isolation requirement ###
- @@@ track number: 16
- track phi 0.581268; track eta 0.26075; track z -4.99683
- track pt   14.4141; dR   0.00946735; Iso_dz   0.00534434; diMuonTmp_Iso   44.6328
- ### Satisfy isolation requirement ###
- @@@ track number: 19
- track phi 0.579113; track eta 0.0877102; track z -5.01719
- track pt   1.58008; dR   0.174987; Iso_dz   0.0150216; diMuonTmp_Iso   46.2129

Tracks statistics
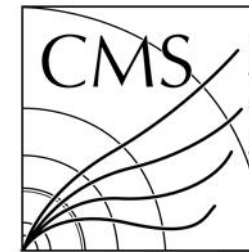
AOD evnet #9

- Number of tracks 377

- =============================

- number of tracks (pt <= 0.5):   163, average track pt: 0.350921

- number of tracks (0.5 < pt <= 2): 188, average track pt: 0.882255

- number of tracks (2 < pt < 10):   21, average track pt: 3.07978

- number of tracks (pt > 10):   5, average track pt: 21.9737

- =============================

MiniAOD event #9

- Number of tracks 87

- =============================

- number of tracks (pt <= 0.5):   0, average track pt: -nan

- number of tracks (0.5 < pt <= 2): 63, average track pt: 1.28006

- number of tracks (2 < pt < 10):   20, average track pt: 3.11162

- number of tracks (pt > 10):   4, average track pt: 24.6152

- =============================

Summary: 2016 AOD vs MiniAOD

- ## Same dimuons
  - Same vertex, same forming muon (position, momentum)
- ## Number of tracks is different in the same event
  - Compared to AOD, MiniAOD has less tracks (mostly missing tracks below 2 GeV)
  - Muon tracks used to form dimuons are not included in MiniAOD track collection, but they do exist in AOD reco track collection
    - Possibly due to the fact that MiniAOD has reduced precision on stored value (next slide)
- ## Tracks pT distribution is different
  - Missing hundreds of tracks under 2GeV (no tracks under 0.5 GeV)
  - 2 GeV and above looks similar

2017 AOD vs MiniAOD
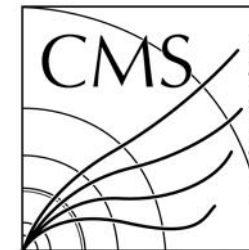
- Above summary is almost true for 2017 AOD vs MiniAOD
  - Except 2017 MiniAOD tracks are significantly improved(comparable to AOD tracks)
  - basically only miss tracks below 0.5 GeV(more in the 2017MiniAOD_Supplementary slides)
    - but maybe people choose not to keep, won't affect our analysis

```
================================
number of tracks (pt <= 0.5):    38, average track pt: 0.344357
number of tracks (0.5 < pt <= 2): 49, average track pt: 0.975673
number of tracks (2 < pt < 10):   17, average track pt: 3.61253
number of tracks (pt > 10):       3, average track pt: 22.6543
================================


================================
number of tracks (pt <= 0.5):     0, average track pt: -nan
number of tracks (0.5 < pt <= 2): 49, average track pt: 0.97571
number of tracks (2 < pt < 10):   17, average track pt: 3.61225
number of tracks (pt > 10):       3, average track pt: 22.651
================================
```

AOD

MiniAOD

Proposed Revise

- Need to revise tamu::helpers::sameTrack()
  - E.g. condition "one->px() - two->px()) < 1e-10" is too strong for miniAOD
  - MiniAOD has reduced precision, a value b/t 1e-1 and 1e-2 seems to be reasonable (need to test)
  - Then we can proceed with 2017 MiniAOD!!!
- Other places where precision would cause a problem? (Be aware)
- Find missing tracks at very low pT(<0.5 GeV)
  - Won't affect our analysis too much, will ask on HyperNews

Isolation dimuonF: AOD
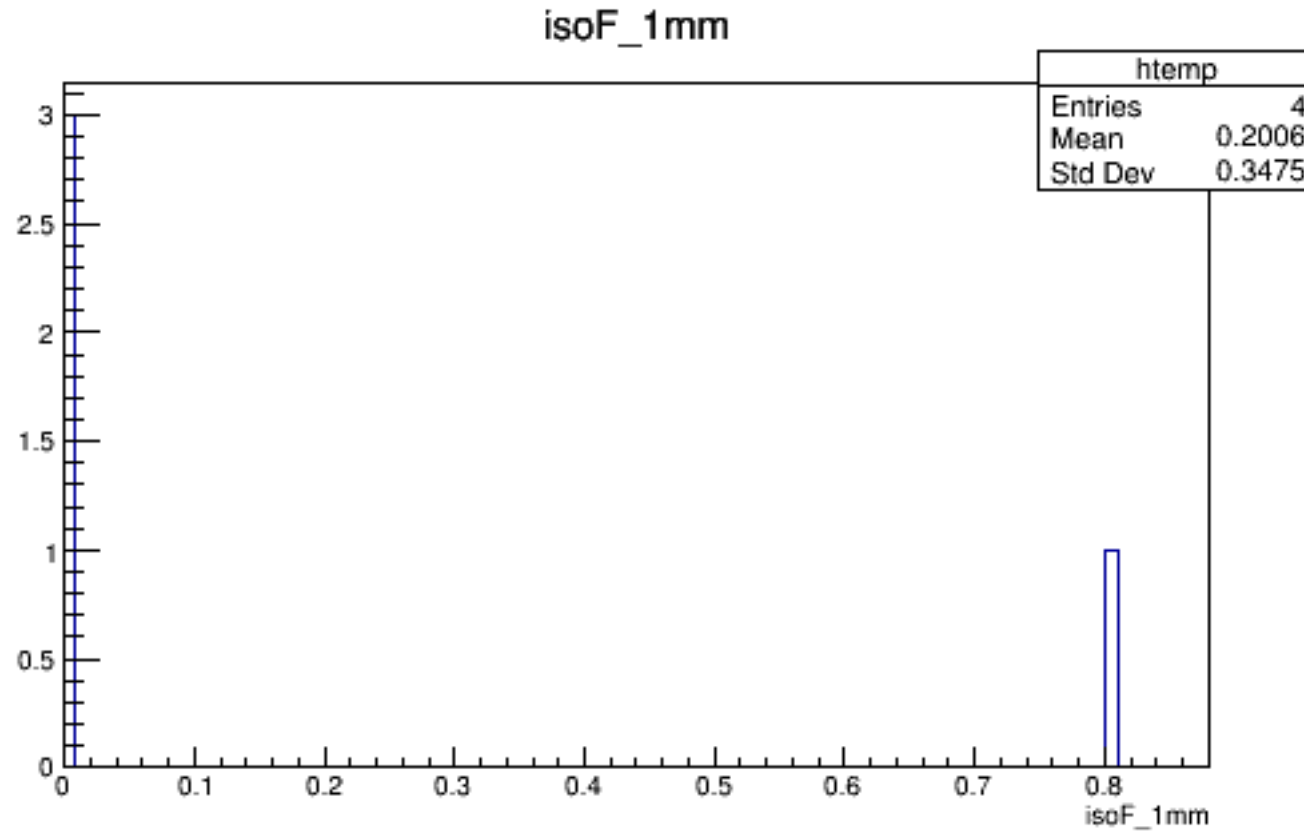
- DarkSUSY private MC mass=0.4GeV, ct=0.5mm, 100 events, AOD

Isolation dimuonF: MiniAOD
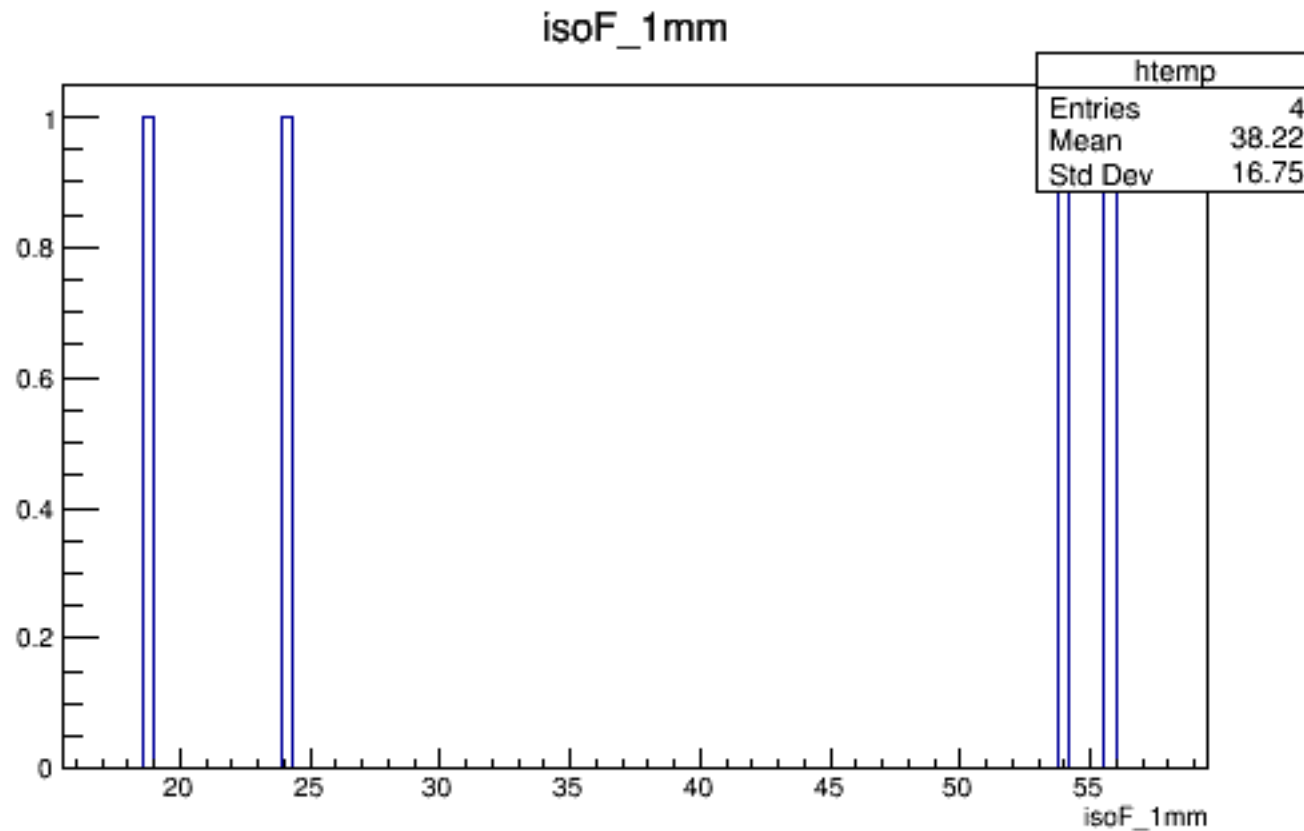
- DarkSUSY private MC mass=0.4GeV, ct=0.5mm, 100 events, MiniAOD

- @@@ i = 2

- diMuon 2: vertex x   2.10958: vertex y   -3.63387: vertex z   -1.32523

-                 vertex phi -1.08273; vertex eta 0.952613; vertex dz -4.99482

-                  vertex px   25.2437: vertex py   -47.5488: vertex pz   59.3993

-         muon_0 px 16.8495; muon_0 py -31.543; muon_0 pz 39.3743; muon_0 pt 35.7613

-         muon_0 vx 0.0814309; muon_0 vy   0.156162; muon_0   vz-6.06152

-         muon_1 px 8.39444; muon_1 py -16.0063; muon_1 pz 20.025; muon_1 pt 18.0739

-         muon_1 vx 0.118605; muon_1 vy 0.175886; muon_1 vz -6.08373

- @@@ track number: 50

- >>> This track is used in dimuon <<<

- track px 16.8495; track py -31.543; track pz 39.3743; track pt 35.7613

- track vx 0.0814309; track vy 0.156162; track vz -6.06152

- @@@ track number: 376

- >>> This track is used in dimuon <<<

- track px 8.39444; track py -16.0063; track pz 20.025; track pt 18.0739

- track vx 0.118605; track vy 0.175886; track vz -6.08373

- @@@ i = 2

- diMuon 2: vertex x   2.10958: vertex y   -3.63387: vertex z   -1.32523

-           vertex phi -1.08273; vertex eta 0.952613; vertex dz -4.99482

-           vertex px   25.2437: vertex py   -47.5488: vertex pz   59.3993

-      muon_0 px 16.8495; muon_0 py -31.543; muon_0 pz 39.3743; muon_0 pt 35.7613

-      muon_0 vx 0.0814309; muon_0 vy 0.156162; muon_0 vz -6.06152

-      muon_1 px 8.39444; muon_1 py -16.0063; muon_1 pz 20.025; muon_1 pt 18.0739

-      muon_1 vx 0.118605; muon_1 vy 0.175886; muon_1 vz -6.08373

- ### Satisfy isolation requirement ###

- @@@ track number: 11

- track phi -1.08783; track eta 0.955657; track z -5.01034

- track pt   18.0781; dR   0.00593164; Iso_dz   0.0155218; diMuonTmp_Iso   18.0781

- ### Satisfy isolation requirement ###

- @@@ track number: 12

- track phi -1.08021; track eta 0.951079; track z -4.98814

- track pt   35.75; dR   0.00295476; Iso_dz   0.00668234; diMuonTmp_Iso   53.8281

Isolation cone

- Characterized by dz < 0.1 cm, dR < 0.4, pT > 0.5 GeV, exclude tracks used in forming dimuon

- *** Number of tracks 753
- @@@ i = 1
- diMuon 1: vertex x -0.775692: vertex y 4.21161: vertex z 10.6958
- vertex phi 1.78199; vertex eta 0.731181; vertex dz 8.4669
- vertex px -11.7171: vertex py 54.6542: vertex pz 44.6105
- muon_0 px -8.11642; muon_0 py 38.5937; muon_0 pz 31.3359; muon_0 pt 39.4379
- muon_0 vx 0.0783088; muon_0 vy 0.16309; muon_0 vz 7.40837
- muon_1 px -3.60055; muon_1 py 16.06; muon_1 pz 13.2746; muon_1 pt 16.4587
- muon_1 vx 0.12356; muon_1 vy 0.172867; muon_1 vz 7.35841
- @@@ track number: 749
- >>> This track is used in dimuon <<<
- track px -8.11642; track py 38.5937; track pz 31.3359; track pt 39.4379
- track vx 0.0783088; track vy 0.16309; track vz 7.40837
- @@@ track number: 753
- >>> This track is used in dimuon <<<
- track px -3.60055; track py 16.06; track pz 13.2746; track pt 16.4587
- track vx 0.12356; track vy 0.172867; track vz 7.35841

- *** Number of tracks 166
- @@@ i = 1
- diMuon 1: vertex x   -0.775692: vertex y   4.21161: vertex z   10.6958
- vertex phi 1.78199; vertex eta 0.731181; vertex dz 8.4669
- vertex px   -11.7171: vertex py   54.6542: vertex pz   44.6105
- muon_0 px -8.11642; muon_0 py 38.5937; muon_0 pz 31.3359; muon_0 pt 39.4379
- muon_0 vx 0.0783088; muon_0 vy 0.16309; muon_0 vz 7.40837
- muon_1 px -3.60055; muon_1 py 16.06; muon_1 pz 13.2746; muon_1 pt 16.4587
- muon_1 vx 0.12356; muon_1 vy 0.172867; muon_1 vz 7.35841
- ### Satisfy isolation requirement ###
- @@@ track number: 3
- track phi 1.79136; track eta 0.737754; track z 8.4318
- track pt   16.4531; dR   0.0114529; Iso_dz   0.0351071; diMuonTmp_Iso   16.4531
- ### Satisfy isolation requirement ###
- @@@ track number: 4
- track phi 1.77808; track eta 0.728416; track z 8.48176
- track pt   39.4375; dR   0.00478362; Iso_dz   0.0148563; diMuonTmp_Iso   55.8906

- @@@ i = 2

- diMuon 2: vertex x   2.16295: vertex y   -0.615982: vertex z   6.26098

-           vertex phi -0.363044; vertex eta -0.493423; vertex dz 8.46584

-           vertex px   17.7519: vertex py   -6.74362: vertex pz   -9.75478

-     muon_0 px 10.1183; muon_0 py -3.77726; muon_0 pz -5.36342; muon_0 pt 10.8004

-     muon_0 vx 0.100136; muon_0 vy 0.156198; muon_0 vz 7.35502

-     muon_1 px 7.6333; muon_1 py -2.96626; muon_1 pz -4.39137; muon_1 pt 8.18938

-     muon_1 vx 0.108916; muon_1 vy 0.179284; muon_1 vz 7.44183

- ### Satisfy isolation requirement ###

- @@@ track number: 90

- track phi -0.555129; track eta -0.260791; track z 8.491

- track pt   0.802595; dR   0.301686; Iso_dz   0.0251598; diMuonTmp_Iso   0.802595

- @@@ track number: 750

- >>> This track is used in dimuon <<<

- track px 7.6333; track py -2.96626; track pz -4.39137; track pt 8.18938

- track vx 0.108916; track vy 0.179284; track vz 7.44183

- @@@ track number: 752

- >>> This track is used in dimuon <<<

- track px 10.1183; track py -3.77726; track pz -5.36342; track pt 10.8004

- track vx 0.100136; track vy 0.156198; track vz 7.35502

- ===========================

- number of tracks (pt <= 0.5):   303, average track pt: 0.346659

- number of tracks (0.5 < pt <= 2): 402, average track pt: 0.892781

- number of tracks (2 < pt < 10):   42, average track pt: 3.35832

- number of tracks (pt > 10):   6, average track pt: 16.3604

- ===========================

- @@@ i = 2
- diMuon 2: vertex x   2.16295: vertex y   -0.615982: vertex z   6.26098
-              vertex phi -0.363044; vertex eta -0.493423; vertex dz 8.46584
-              vertex px   17.7519: vertex py   -6.74362: vertex pz   -9.75478
-        muon_0 px 10.1183; muon_0 py -3.77726; muon_0 pz -5.36342; muon_0 pt 10.8004
-        muon_0 vx 0.100136; muon_0 vy 0.156198; muon_0 vz 7.35502
-        muon_1 px 7.6333; muon_1 py -2.96626; muon_1 pz -4.39137; muon_1 pt 8.18938
-        muon_1 vx 0.108916; muon_1 vy 0.179284; muon_1 vz 7.44183
- ### Satisfy isolation requirement ###
- @@@ track number: 12
- track phi -0.357336; track eta -0.478103; track z 8.42839
- track pt   10.7969; dR   0.016349; Iso_dz   0.0374509; diMuonTmp_Iso   10.7969
- ### Satisfy isolation requirement ###
- @@@ track number: 13
- track phi -0.370618; track eta -0.513443; track z 8.5152
- track pt   8.1875; dR   0.021405; Iso_dz   0.0493574; diMuonTmp_Iso   18.9844
- =============================
- number of tracks (pt <= 0.5):   0, average track pt: -nan
- number of tracks (0.5 < pt <= 2): 121, average track pt: 1.32036
- number of tracks (2 < pt < 10):   39, average track pt: 3.36659
- number of tracks (pt > 10):   6, average track pt: 16.3581
- =============================

- *** Number of tracks 669

- @@@ i = 1

- diMuon 1: vertex x   17.1407: vertex y   -5.03711: vertex z   -2.863

-        vertex phi 2.84504; vertex eta 0.150342; vertex dz 0.898613

-              vertex px   -42.9022: vertex py   13.1093: vertex pz   6.76982

-        muon_0 px -28.3608; muon_0 py 8.61811; muon_0 pz 4.47235; muon_0 pt 29.6413

-        muon_0 vx 0.114571; muon_0 vy 0.200756; muon_0 vz -0.17426

-        muon_1 px -14.5425; muon_1 py 4.4915; muon_1 pz 2.29747; muon_1 pt 15.2203

-        muon_1 vx 0.0853839; muon_1 vy 0.105737; muon_1 vz -0.175001

- ### Satisfy isolation requirement ###

- @@@ track number: 177

- track phi 2.535; track eta 0.352272; track z 0.858432

- track pt   0.603729; dR   0.370003; Iso_dz   0.040181; diMuonTmp_Iso   0.603729

- @@@ track number: 597

- >>> This track is used in dimuon <<<

- track px -14.5425; track py 4.4915; track pz 2.29747; track pt 15.2203

- track vx 0.0853839; track vy 0.105737; track vz -0.175001

- @@@ track number: 598

- >>> This track is used in dimuon <<<

- track px -28.3608; track py 8.61811; track pz 4.47235; track pt 29.6413

- track vx 0.114571; track vy 0.200756; track vz -0.17426

- *** Number of tracks 165
- @@@ i = 1
- diMuon 1: vertex x   17.1407: vertex y   -5.03711: vertex z   -2.863
- vertex phi 2.84504; vertex eta 0.150342; vertex dz 0.898613
- vertex px   -42.9022: vertex py   13.1093: vertex pz   6.76982
- muon_0 px -28.3608; muon_0 py 8.61811; muon_0 pz 4.47235; muon_0 pt 29.6413
- muon_0 vx 0.114571; muon_0 vy 0.200756; muon_0 vz -0.17426
- muon_1 px -14.5425; muon_1 py 4.4915; muon_1 pz 2.29747; muon_1 pt 15.2203
- muon_1 vx 0.0853839; muon_1 vy 0.105737; muon_1 vz -0.175001
- ### Satisfy isolation requirement ###
- @@@ track number: 12
- track phi 2.84208; track eta 0.150334; track z 0.898388
- track pt   15.2188; dR   0.00296141; Iso_dz   0.000225018; diMuonTmp_Iso   15.2188
- ### Satisfy isolation requirement ###
- @@@ track number: 13
- track phi 2.84657; track eta 0.150334; track z 0.899129
- track pt   29.6406; dR   0.00153043; Iso_dz   0.000516292; diMuonTmp_Iso   44.8594

- @@@ i = 2
- diMuon 2: vertex x   0.791402: vertex y   0.381039: vertex z   0.82964
-         vertex phi 0.29287; vertex eta 1.11756; vertex dz 0.921954
-             vertex px   53.4971: vertex py   16.1316: vertex pz   76.2799
-         muon_0 px 28.5779; muon_0 py 8.75946; muon_0 pz 40.9766; muon_0 pt 29.8902
-         muon_0 vx 0.10437; muon_0 vy 0.17013; muon_0 vz -0.152524
-         muon_1 px 24.9193; muon_1 py 7.37214; muon_1 pz 35.3033; muon_1 pt 25.987
-         muon_1 vx 0.102103; muon_1 vy 0.177844; muon_1 vz -0.148642
- @@@ track number: 111
- >>> This track is used in dimuon <<<
- track px 24.9193; track py 7.37214; track pz 35.3033; track pt 25.987
- track vx 0.102103; track vy 0.177844; track vz -0.148642
- @@@ track number: 112
- >>> This track is used in dimuon <<<
- track px 28.5779; track py 8.75946; track pz 40.9766; track pt 29.8902
- track vx 0.10437; track vy 0.17013; track vz -0.152524
- ==============================
- number of tracks (pt <= 0.5):   279, average track pt: 0.340225
- number of tracks (0.5 < pt <= 2): 335, average track pt: 0.905273
- number of tracks (2 < pt < 10):   49, average track pt: 2.85044
- number of tracks (pt > 10):   6, average track pt: 21.4572
- ==============================

- @@@ i = 2
- diMuon 2: vertex x   0.791402: vertex y   0.381039: vertex z   0.82964
- vertex phi 0.29287; vertex eta 1.11756; vertex dz 0.921954
- vertex px   53.4971: vertex py   16.1316: vertex pz   76.2799
- muon_0 px 28.5779; muon_0 py 8.75946; muon_0 pz 40.9766; muon_0 pt 29.8902
- muon_0 vx 0.10437; muon_0 vy 0.17013; muon_0 vz -0.152524
- muon_1 px 24.9193; muon_1 py 7.37214; muon_1 pz 35.3033; muon_1 pt 25.987
- muon_1 vx 0.102103; muon_1 vy 0.177844; muon_1 vz -0.148642
- ### Satisfy isolation requirement ###
- @@@ track number: 5
- track phi 0.297373; track eta 1.12101; track z 0.920872
- track pt   29.8906; dR   0.00567015; Iso_dz   0.00108116; diMuonTmp_Iso   29.8906
- ### Satisfy isolation requirement ###
- @@@ track number: 6
- track phi 0.287606; track eta 1.11368; track z 0.924756
- track pt   25.9844; dR   0.00653834; Iso_dz   0.00280288; diMuonTmp_Iso   55.875
- =============================
- number of tracks (pt <= 0.5):   0, average track pt: -nan
- number of tracks (0.5 < pt <= 2): 116, average track pt: 1.29762
- number of tracks (2 < pt < 10):   44, average track pt: 2.79861
- number of tracks (pt > 10):   5, average track pt: 22.1516
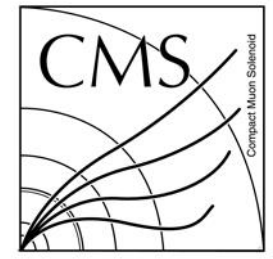- =============================

- *** 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
- @@@ 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
- @@@ 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

- *** 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
- ### Satisfy isolation requirement ###
- @@@ track number: 3
- 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
- ### Satisfy isolation requirement ###
- @@@ track number: 4
- 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

- @@@ i = 2
- diMuon 2: vertex x   0.516913: vertex y   -0.857014: vertex z   -3.89891
-                 vertex phi -1.17943; vertex eta 0.132575; vertex dz -2.97249
-       vertex px 9.22324: vertex py -22.3511: vertex pz 3.21496
-       muon_0 px 5.86997; muon_0 py -14.4441; muon_0 pz 1.92474; muon_0 pt 15.5913
-       muon_0 vx 0.0998593; muon_0 vy 0.166645; muon_0 vz -4.03239
-       muon_1 px 3.35319; muon_1 py -7.90678; muon_1 pz 1.29022; muon_1 pt 8.58843
-       muon_1 vx 0.0874476; muon_1 vy 0.161293; muon_1 vz -4.07107
- @@@ track number: 78
- >>> This track is used in dimuon <<<
- track px 3.35319; track py -7.90678; track pz 1.29022; track pt 8.58843
- track vx 0.0874476; track vy 0.161293; track vz -4.07107
- @@@ track number: 642
- >>> This track is used in dimuon <<<
- track px 5.86997; track py -14.4441; track pz 1.92474; track pt 15.5913
- track vx 0.0998593; track vy 0.166645; track vz -4.03239
- =============================
- number of tracks (pt <= 0.5):   259, average track pt: 0.342681
- number of tracks (0.5 < pt <= 2): 342, average track pt: 0.93211
- number of tracks (2 < pt < 10):   39, average track pt: 3.01602
- number of tracks (pt > 10):   3, average track pt: 17.1993
- =============================

- @@@ i = 2
- diMuon 2: vertex x 0.516913: vertex y -0.857014: vertex z -3.89891
- vertex phi -1.17943; vertex eta 0.132575; vertex dz -2.97249
- vertex px 9.22324: vertex py -22.3511: vertex pz 3.21496
- muon_0 px 5.86997; muon_0 py -14.4441; muon_0 pz 1.92474; muon_0 pt 15.5913
- muon_0 vx 0.0998593; muon_0 vy 0.166645; muon_0 vz -4.03239
- muon_1 px 3.35319; muon_1 py -7.90678; muon_1 pz 1.29022; muon_1 pt 8.58843
- muon_1 vx 0.0874476; muon_1 vy 0.161293; muon_1 vz -4.07107
- ### Satisfy isolation requirement ###
- @@@ track number: 7
- track phi -1.16967; track eta 0.149602; track z -2.99769
- track pt 8.58594; dR 0.0196279; Iso_dz 0.0252054; diMuonTmp_Iso 8.58594
- ### Satisfy isolation requirement ###
- @@@ track number: 8
- track phi -1.1848; track eta 0.123051; track z -2.959
- track pt 15.5938; dR 0.0109349; Iso_dz 0.0134863; diMuonTmp_Iso 24.1797
- =============================
- number of tracks (pt <= 0.5):   0, average track pt: -nan
- number of tracks (0.5 < pt <= 2): 120, average track pt: 1.31864
- number of tracks (2 < pt < 10):   31, average track pt: 2.82416
- number of tracks (pt > 10):   3, average track pt: 17.2005
- =============================

From HN

- Some tracks were missing or had different pt, eta in MiniAOD version up to 2016.

- In new miniaod this has been improved and if you sum packedPFCandidate with lostTracks collection you should get all highpurity generalTracks.   (Andrea Rizzi)

- https://hypernews.cern.ch/HyperNews/CMS/get/physTools/3555/1.html

Isolation dimuonC: AOD
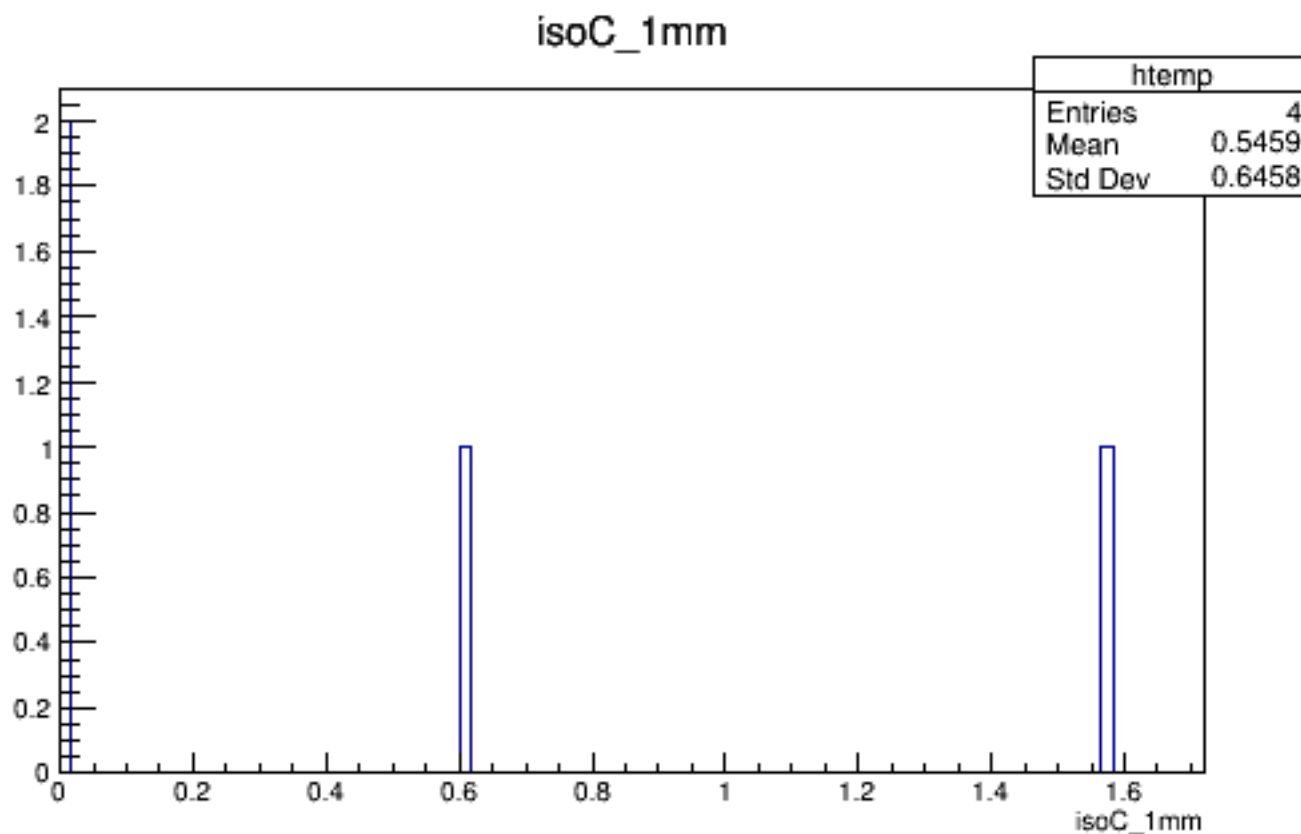
- Use a private DarkSUSY MC sample 100 events, mass=0.4GeV, ct=0.5mm, AOD

AOD Isolation dimuonC
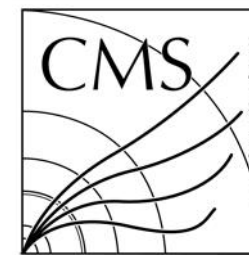
- Event
  - #9: Tracks number 377
    - Track #65, #377 are used to build dimuonC
    - track number #63: phi 0.579156; eta 0.0877341; pt 1.5798; dz -5.0172; dR 0.174961; Iso dz 0.0150237; diMuonTmp_Iso 1.5798
  - #14: Tracks number 753
    - Track #749, #753 are used to build dimuonC
  - #22: Tracks number 669
    - Track #597, #598 are used to build dimuonC
    - track #177: phi 2.535; eta 0.352272; pt 0.603729; dz 0.858432; dR 0.370003; Iso dz 0.040181; diMuonTmp_Iso 0.603729
  - #57: Tracks number 643
    - Track #643 and #641 are used to build dimuonC

Isolation dimuonC: MiniAOD
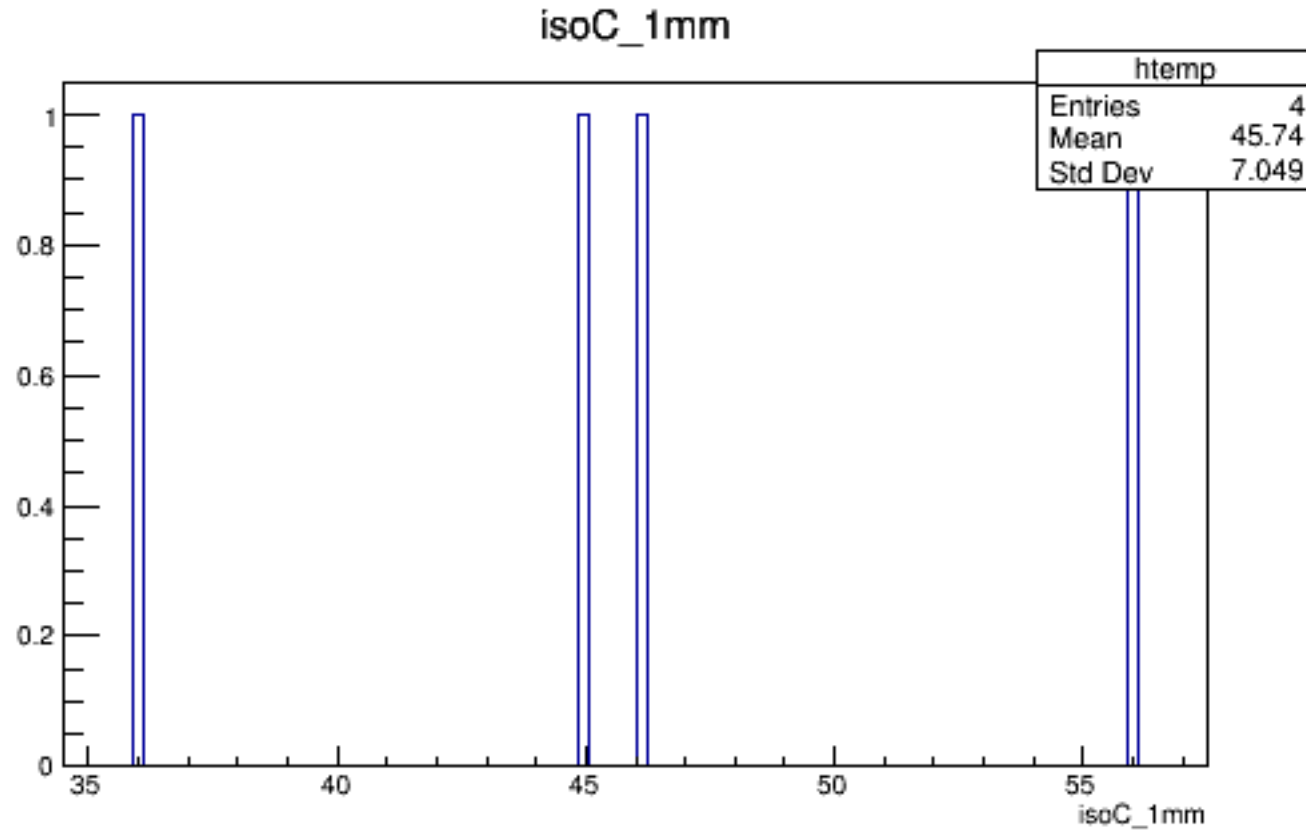
- DarkSUSY private MC mass=0.4GeV, ct=0.5mm, 100 events, MiniAOD

MiniAOD Isolation dimuonC
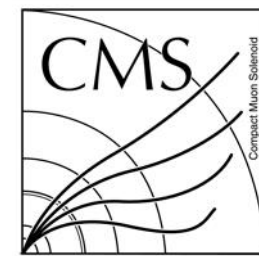
- Event
  - #9: Tracks number 87
    - track #15: phi 0.595038; eta 0.262947; pt 30.2187; dz -5.0054; dR 0.00447746; Iso dz 0.00322276; diMuonTmp_Iso 30.2187
    - track #16: phi 0.581268; eta 0.26075; pt 14.4141; dz -4.99683; dR 0.00946735; Iso dz 0.00534434; diMuonTmp_Iso 44.6328
    - track #19: phi 0.579113; eta 0.0877102; pt 1.58008; dz -5.01719; dR 0.174987; Iso dz 0.0150216; diMuonTmp_Iso 46.2129
  - #14: Tracks number: 166
    - track #3: phi 1.79136; eta 0.737754; pt 16.4531; dz 8.4318; dR 0.0114529; Iso dz 0.0351071; diMuonTmp_Iso 16.4531
    - track #4: phi 1.77808; eta 0.728416; pt 39.4375; dz 8.48176; dR 0.00478362; Iso dz 0.0148563; diMuonTmp_Iso 55.8906
  - #22: Tracks number: 165
    - track #12: phi 2.84208; eta 0.150334; pt 15.2188; dz 0.898388; dR 0.00296141; Iso dz 0.000225018; diMuonTmp_Iso 15.2188
    - track #13: phi 2.84657; eta 0.150334; pt 29.6406; dz 0.899129; dR 0.00153043; Iso dz 0.000516292; diMuonTmp_Iso 44.8594
  - #57: Tracks number: 154
    - track #3: phi 2.95029; eta 0.867031; pt 20.0469; dz -2.99589; dR 0.00788699; Iso dz 0.00730146; diMuonTmp_Iso 20.0469
    - track #4: phi 2.93583; eta 0.856777; pt 15.9609; dz -2.97997; dR 0.00983577; Iso dz 0.00861957; diMuonTmp_Iso 36.0078
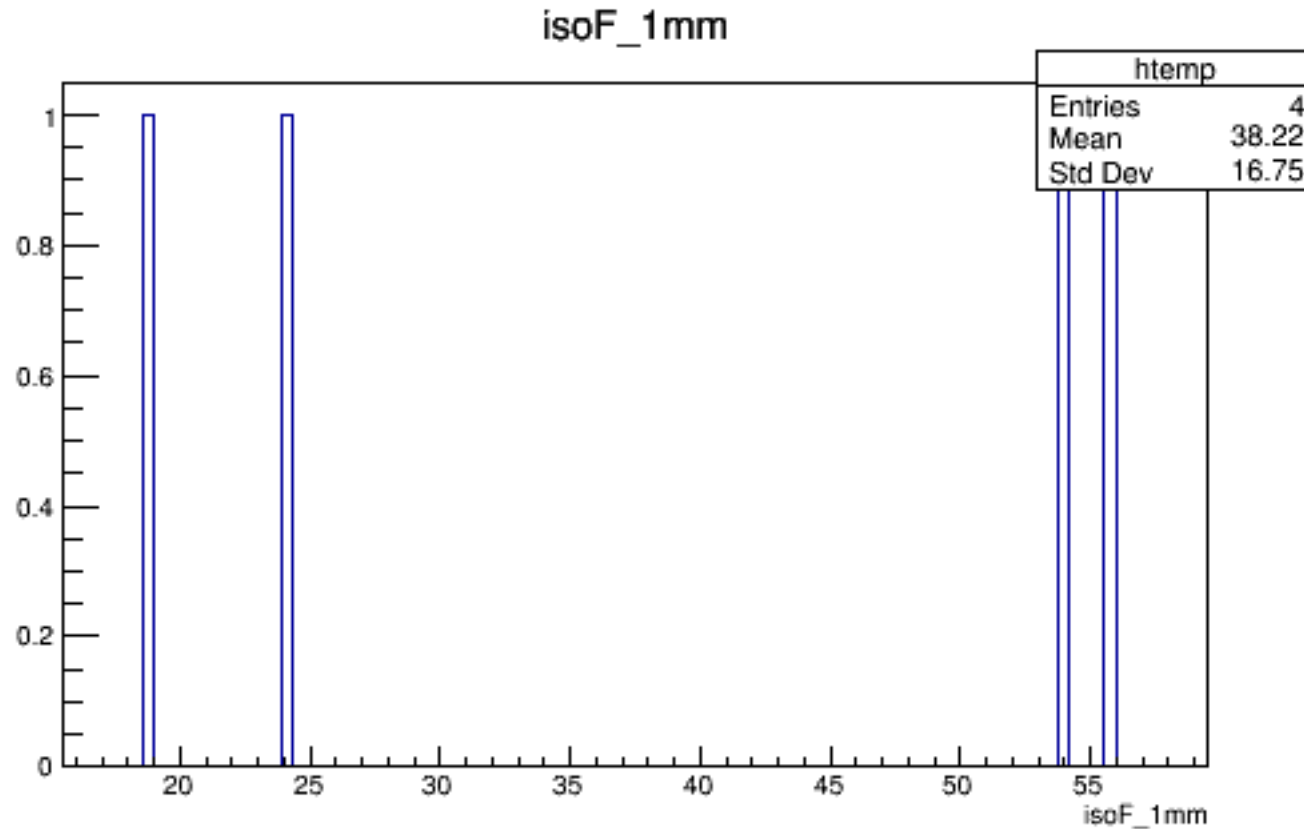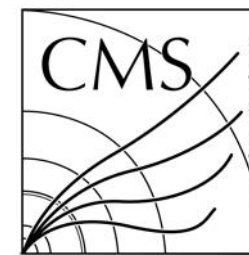
Isolation dimuonF: AOD
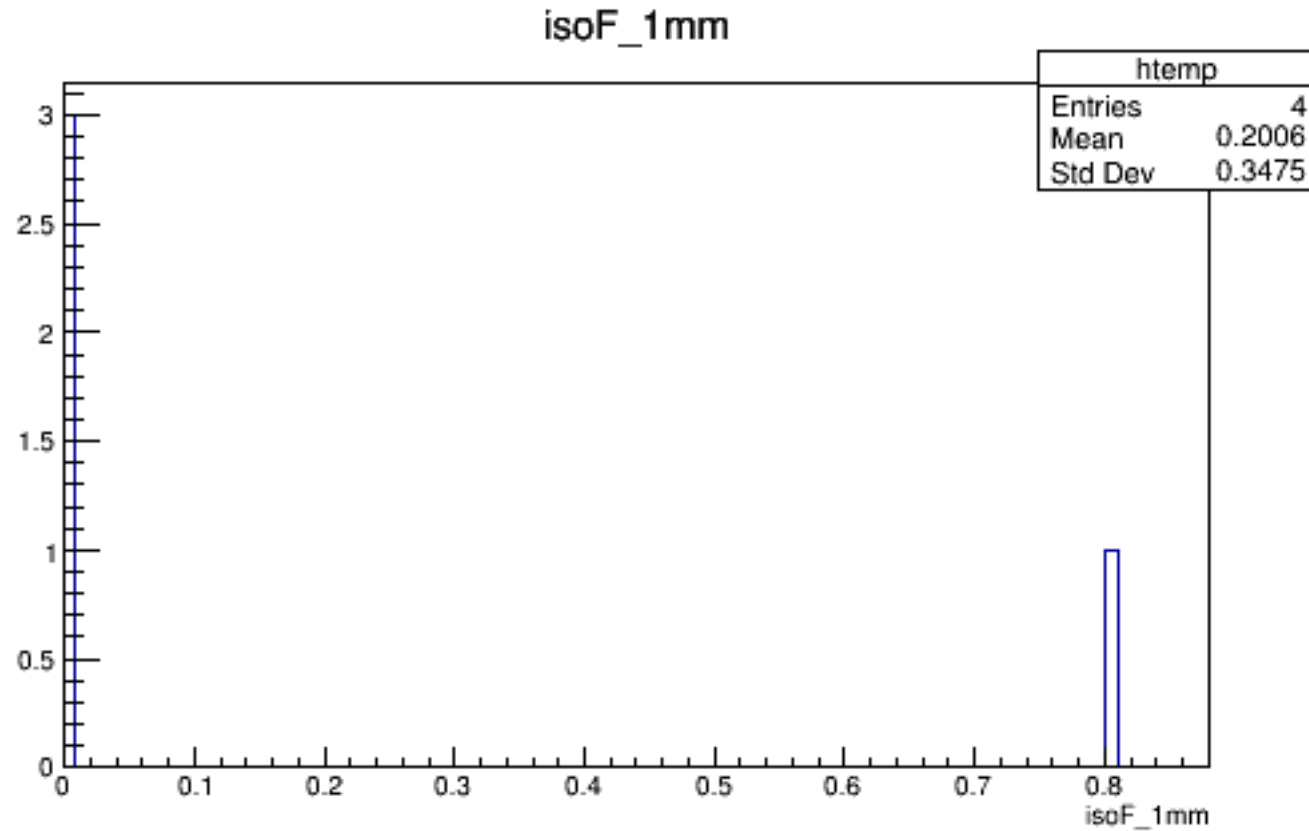
- DarkSUSY private MC mass=0.4GeV, ct=0.5mm, 100 events, AOD

AOD Isolation dimuonF

- Event
  - #9: Tracks number 377
    - Track #50 and #376 are used to build dimuonF
  - #14: Tracks number 753
    - Track #750 and #752 are used to build dimuonF
    - track #90: phi -0.555129; eta -0.260791; pt 0.802595; dz 8.491; dR 0.301686; Iso dz 0.0251598; diMuonTmp_Iso 0.802595
  - #22: Tracks number 669
    - Track #111 and #112 are used to build dimuonF
  - #57: Tracks number 643
    - Track #642 and #78 are used to build dimuonF

Isolation dimuonF: MiniAOD

- DarkSUSY private MC mass=0.4GeV, ct=0.5mm, 100 events, MiniAOD

MiniAOD Isolation dimuonF

- Event
  - #9: Tracks number 87
    - track #11: phi -1.08783; eta 0.955657; pt 18.0781; dz -5.01034; dR 0.00593164; Iso dz 0.0155218; diMuonTmp_Iso 18.0781
    - track #12: phi -1.08021; eta 0.951079; pt 35.75; dz -4.98814; dR 0.00295476; Iso dz 0.00668234; diMuonTmp_Iso 53.8281
  - #14: Tracks number 166
    - track #12: phi -0.357336; eta -0.478103; pt 10.7969; dz 8.42839; dR 0.016349; Iso dz 0.0374509; diMuonTmp_Iso 10.7969
    - track #13: phi -0.370618; eta -0.513443; pt 8.1875; dz 8.5152; dR 0.021405; Iso dz 0.0493574; diMuonTmp_Iso 18.9844
  - #22: Tracks number: 165
    - track #5: phi 0.297373; eta 1.12101; pt 29.8906; dz 0.920872; dR 0.00567015; Iso dz 0.00108116; diMuonTmp_Iso 29.8906
    - track #6: phi 0.287606; eta 1.11368; pt 25.9844; dz 0.924756; dR 0.00653834; Iso dz 0.00280288; diMuonTmp_Iso 55.875
  - #57: Tracks number: 154
    - track #7: phi -1.16967; eta 0.149602; pt 8.58594; dz -2.99769; dR 0.0196279; Iso dz 0.0252054; diMuonTmp_Iso 8.58594
    - track #8: phi -1.1848; eta 0.123051; pt 15.5938; dz -2.959; dR 0.0109349; Iso dz 0.0134863; diMuonTmp_Iso 24.1797

Summary
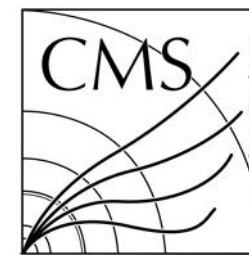
- AOD
  - Four times more general tracks than MiniAOD "packedPFcandidate + lost tracks"

- MiniAOD
  - At least missing tracks which are used to build the dimuons
  - Larger track pT (one order magnitude larger than AOD generalTracks)

- Use 2017 MC/data for the isolation study?
  - Some tracks were missing or had different pt, eta in MiniAOD version up to 2016

- Other checks that can help investigate?

MiniAOD Cutflow Table

Total number of events: 100

Total number of events with 4mu: 100 fraction: 1

********** GEN **********

Selection	nEv	RelEff	Eff
pT1>17 |eta1|<0.9:	37	0.37	0.37
pT2>8 |eta2|<2.4:	32	0.864865	0.32
pT3>8 |eta2|<2.4:	21	0.65625	0.21
pT4>8 |eta2|<2.4:	7	0.333333	0.07
Basic MC Acceptance:	0.07		

********** RECO **********

Selection	nEv	RelEff	Eff
m_events1SelMu17:	37	0.37	0.37
m_events2SelMu8:	31	0.837838	0.31
m_events3SelMu8:	19	0.612903	0.19
m_events4SelMu8:	7	0.368421	0.07
Basic Acceptance:	0.07		
Basic MC Accept. a_gen:	0.07		
m_events2MuJets:	4	0.571429	0.04
m_events2DiMuons:	4	1	0.04

AOD cutflow table

Total number of events: 100

Total number of events with 4mu: 100 fraction: 1

********** GEN **********

Selection	nEv	RelEff	Eff
pT1>17 |eta1|<0.9:	37	0.37	0.37
pT2>8 |eta2|<2.4:	32	0.864865	0.32
pT3>8 |eta2|<2.4:	21	0.65625	0.21
pT4>8 |eta2|<2.4:	7	0.333333	0.07

Basic MC Acceptance: 0.07

********** RECO **********

| Selection	nEv	RelEff	Eff
m_events1SelMu17:	37	0.37	0.37
m_events2SelMu8:	31	0.837838	0.31
m_events3SelMu8:	19	0.612903	0.19
m_events4SelMu8:	7	0.368421	0.07
Basic Acceptance:	0.07		
Basic MC Accept. a_gen:	0.07		
m_events2MuJets:	4	0.571429	0.04
m_events2DiMuons:	4	1	0.04

Branch

- Forked cms-tamu/MuJetAnalysis to my local github account
  - Work on the "for-CMSSW-80X-NoPHR-RAWAODSIM" branch (used in 2016 analysis)
  - To setup: https://twiki.cern.ch/twiki/bin/view/CMS/MuonJets2016#Test_MiniAOD
  - https://github.com/weishi10141993/MuJetAnalysis/tree/for-CMSSW-80X-NoPHR-RAWAODSIM
- Comparison
  - /DoubleMuon/Run2016E-23Sep2016-v1/AOD
  - /DoubleMuon/Run2016E-23Sep2016-v1/MINIAOD
  - The number of events is similar
    - Number of events in Events is: 387 (MiniAOD) vs 376(AOD)
    - Number of events in Events_orphan is: 209696 (MiniAOD) vs 203237(AOD)
  - Found discrepancy in dimuon isolation distribution branch
    - e.g. cutFlowAnalyzerPXBL2PXFL2_Data, "isoC_1mm" (sum of track pT around dimuon C)
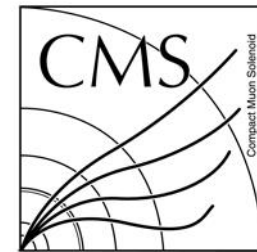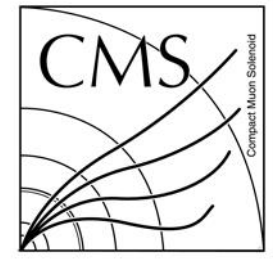
Plots: dimuon mass
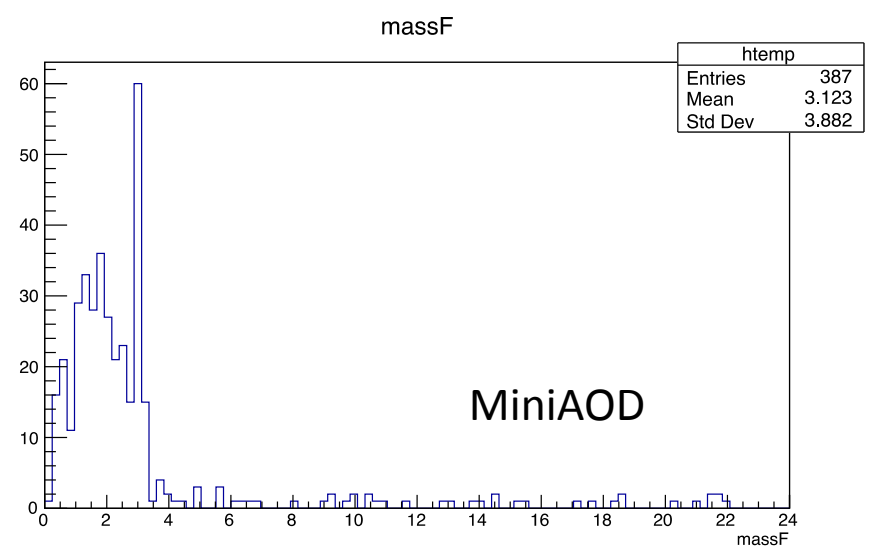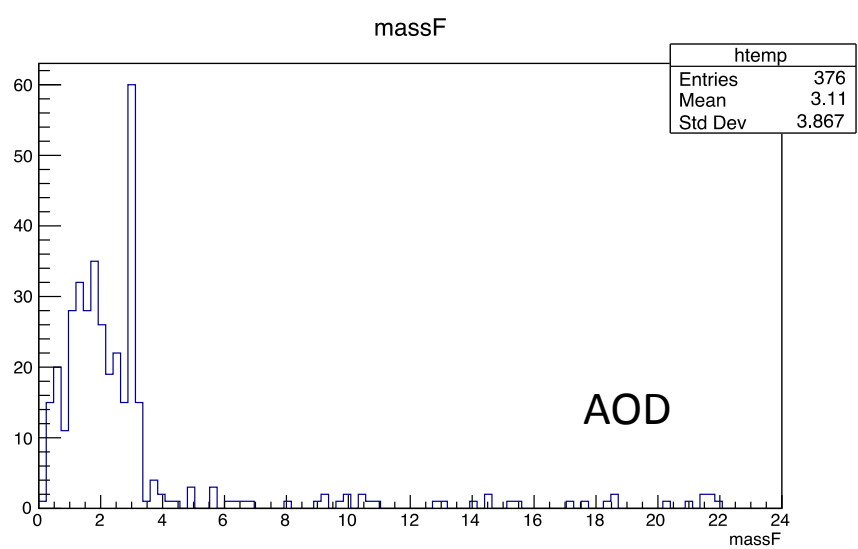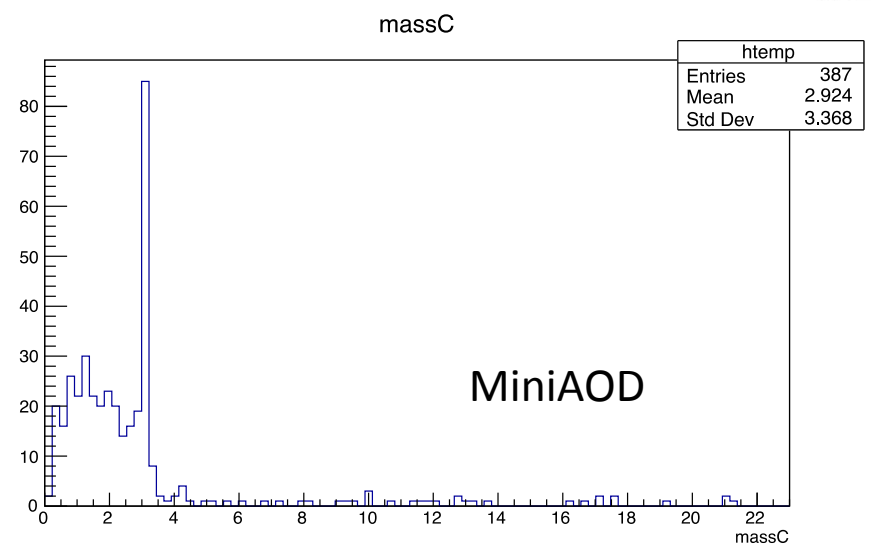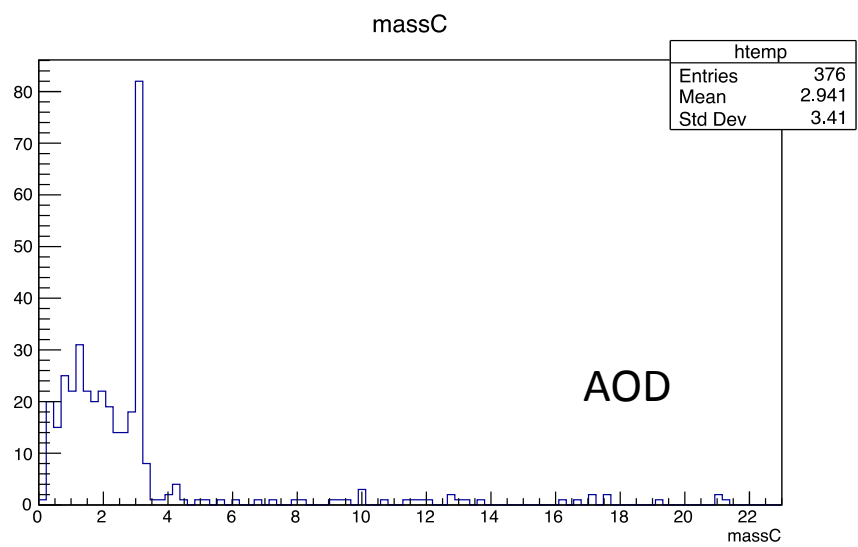
Plots: dimuon isolation
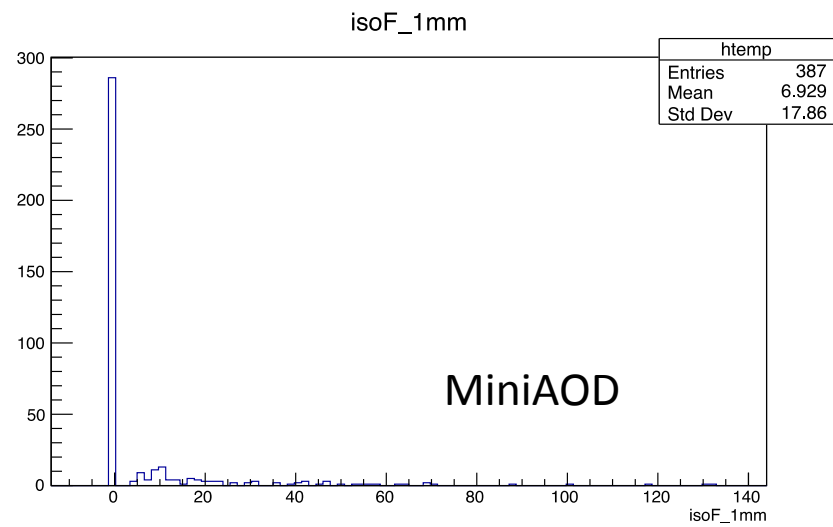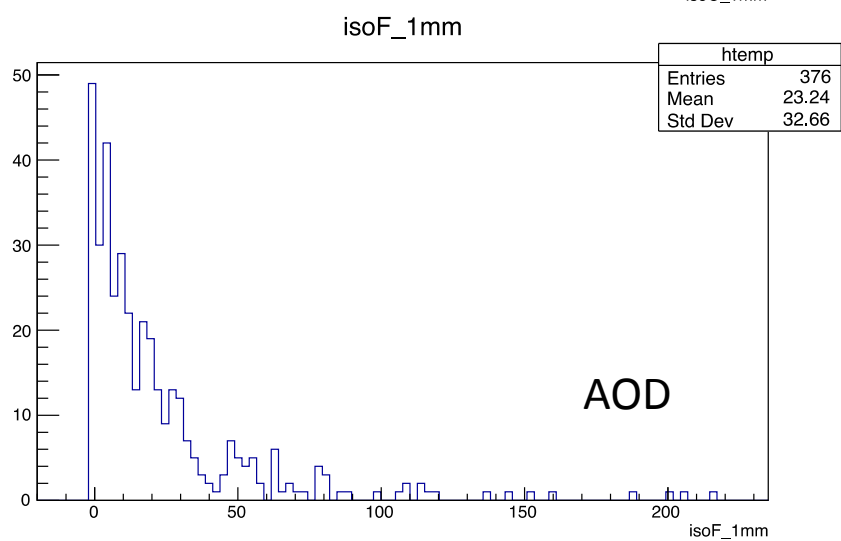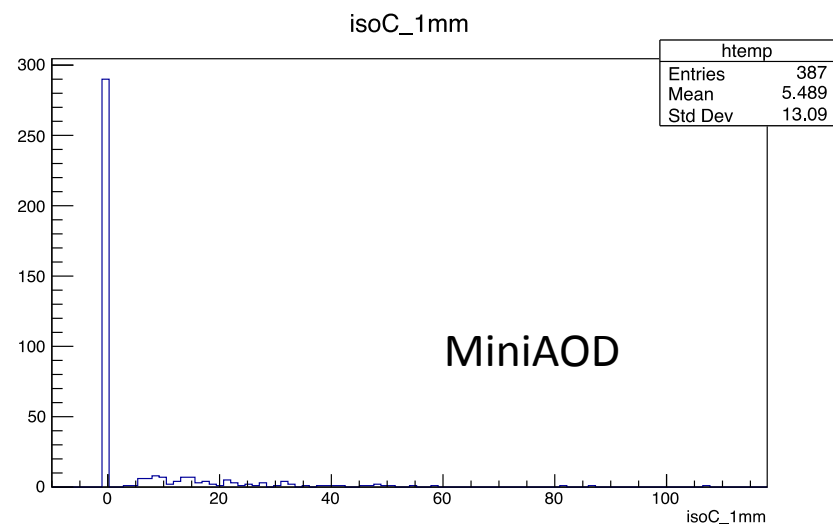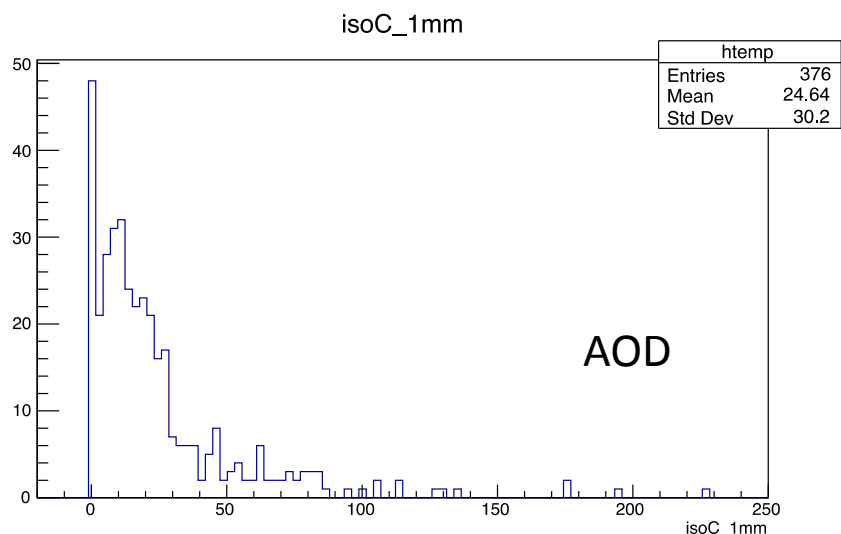
Investigate on dimuon isolation

- AOD used "generalTracks" when summarizing the tracks close to a dimuon
  - Collection of tracks obtained with tracker-standalone reconstruction (tracker track)
  - This tag is not in MiniAOD
  - https://twiki.cern.ch/twiki/bin/view/CMSPublic/SWGuideRecoDataTable
- Last time Sven asked in HN
  - People suggest use "packedPFCandidates"
  - Get track collection by unpacking the track information in packedPFcandidates and elsewhere in the event using the PATTrackAndVertexUnpacker
  - Checked with Luca last week, the average isolation pT summation("isoC_1mm") is larger than the AOD(24.64 GeV vs MiniAOD 68.06 GeV)
- Currently I use "innerTrack()" associated with "slimmedMuons"
  - The corresponding muon tracker track in MiniAOD format
  - Isolation pT summation is smaller than AOD isolation (24.64 GeV vs MiniAOD 5.489 GeV, see previous slide)
  - Not enough, need to include inner tracks of more physics objects besides muons, like e/γ, tau, hadron, etc.
  - Check "packedPFCandidates" again
- Question: dimuon isolation uses all physics objects' inner tracks?