Z' -> Di Muon Analysis

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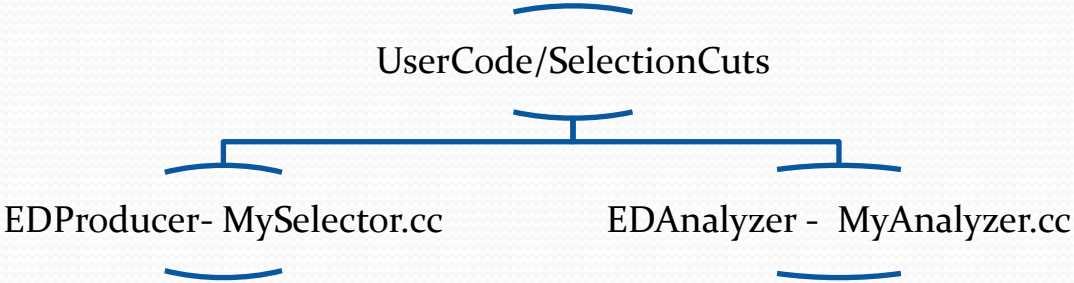
- Target : 13/14 Tev Zprime Analsis.
- Starting to do with the CMS DAS 2014@FNAL Zprim Di Muon exercise.
- Enviroment :
- cmsrel CMSSW_5_3_11
- cd CMSSW_5_3_11/src
- Cmsenv
- cp Zprime analysis package to the current Dir
- scram b
- GlobalTag : START53_V7A
- dataset=
- /RelValZMM/CMSSW_5_3_6-START53_V14-v2/GEN-SIM-RECO/
- No. of Events = 100 for testing the package

Muon Selection

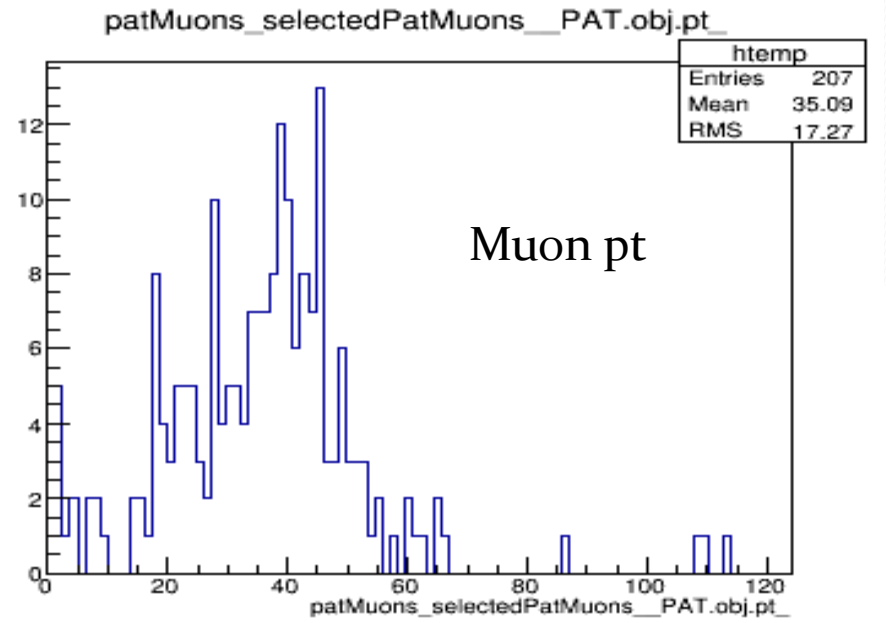


We modify EDProducer modified to runs over the entire muon and copies muons to the new collection which pass the looseMuon cuts

pt > 7
|eta| < 2.4
muon is a Global Muon
muon is a Tracker Muon
muon has 1 or more valid pixel hits
muon has 5 or more hits with tracker layers
muon has dxy impact parameter < 0.2 with respect to the (0, 0, 0)
muon has 1 or more valid muon hits
number of muon matches > 1
muon is isolated [(tracker iso) / muon pt < 0.1]

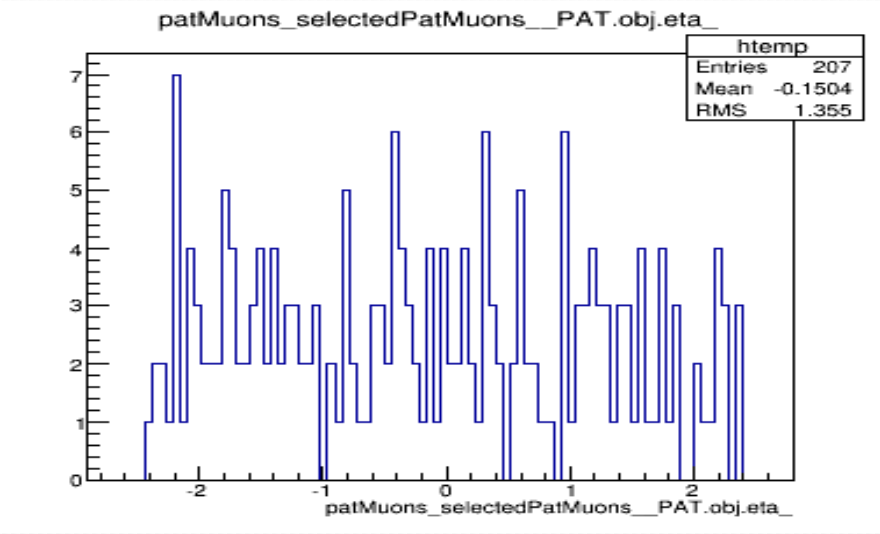
To get the number of hits we will use
"(mu.globalTrack()->hitPattern().numberOfValidPixelHits())> 0"

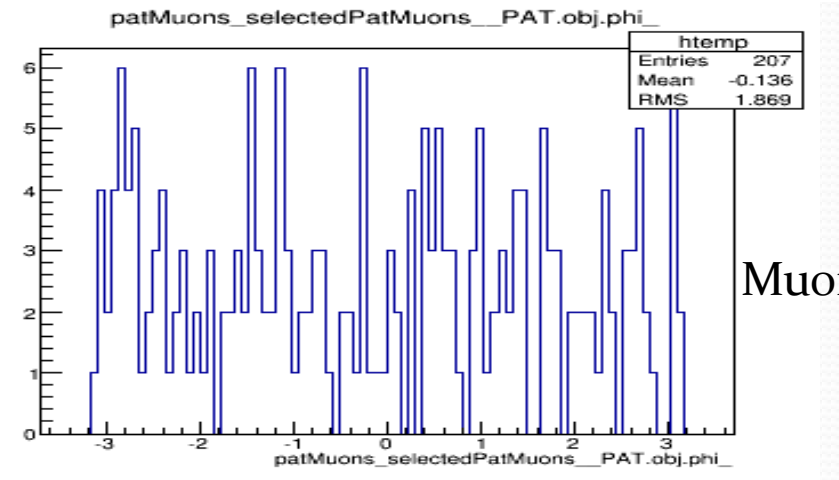
Muon Kinematics



Muon pt

Muon eta





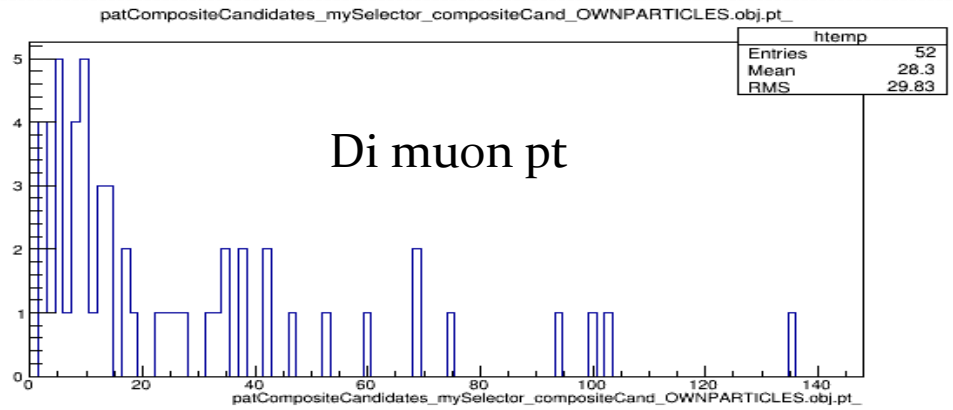
Muon phi

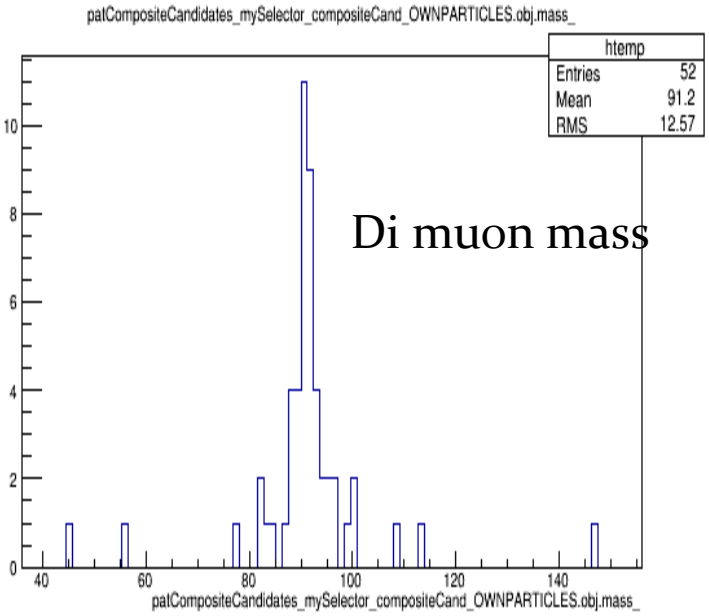
Dimuon Selection

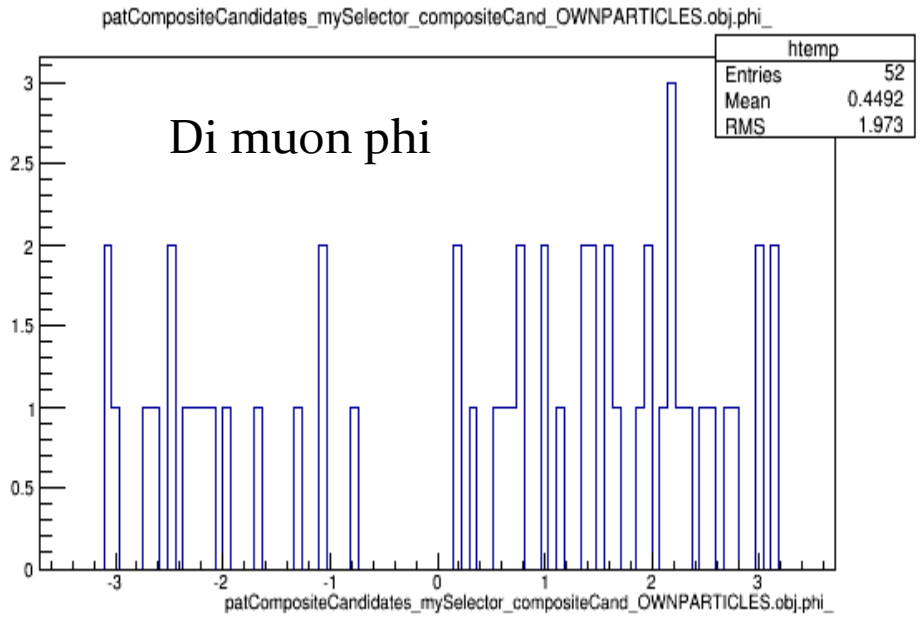
- **Step 1: Making the dimuon**
- Now we will make a collection of dimuons using the new muon collection we previously made. Loop over the muons and get two different muons of opposite charge

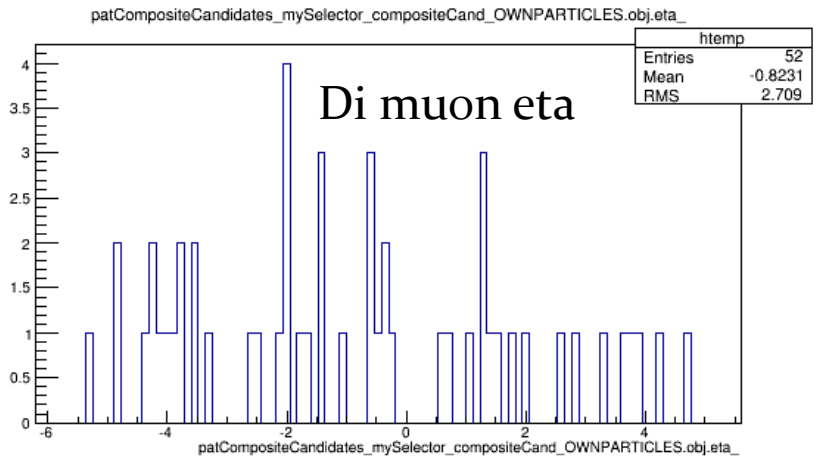
```
Handle< View<Muon> > muons;
iEvent.getByLabel("selectedPatMuons", muons);
 for(edm::View<pat::Muon>::const_iterator muon1=muons->begin(); muon1!=muons->end(); ++muon1){ if (looseCuts(*muon1)) looseMuons->push_back(*muon1); }
for(MuonCollection::const_iterator muon1=looseMuons->begin(); muon1!=looseMuons->end(); ++muon1)
{ for(MuonCollection::const_iterator muon2=looseMuons->begin(); muon2!=looseMuons->end(); ++muon2)
{ if( muon2 > muon1 )
{ pat::CompositeCandidate di;
 di.addDaughter(*muon1);
di.addDaughter(*muon2);
di.setCharge(0);
di.setP4(muon1->p4()+muon2->p4());
 compositeCand->push_back(di);
 } } }
iEvent.put(compositeCand, "compositeCand");
iEvent.put(looseMuons, "looseMuons"); ...
```

Di-Muon Kinematics









Step 3: Dimuon cuts

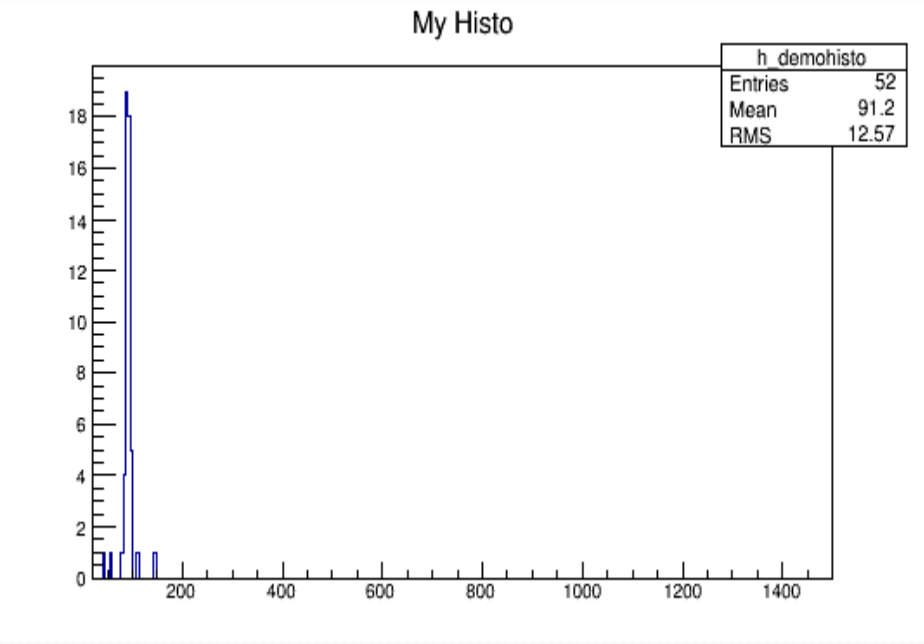
- 1) passesVertexCuts: which will only allow the loop to continue if both muons come from the same vertex.
- 2) tightCuts:" Global muon with additional muon quality requirements" cuts on one of the two muons and usually requires that one of the muons fired the trigger. We require one muon to have pt > 41 GeV.

Step 2: Making the histogram

- using the new CompositeCandidate collection as input.
- Do this in the EDAnalyzer.

```
Handle< View<CompositeCandidate> > cands; iEvent.getByLabel("mySelector",
"compositeCand", cands);
for(View<CompositeCandidate>::const_iterator cand1=cands->begin(); cand1!=cands->end();
++cand1){
h_demohisto ->Fill( cand1->mass() );
  }
```

PATComposite mass histogram



Isolation

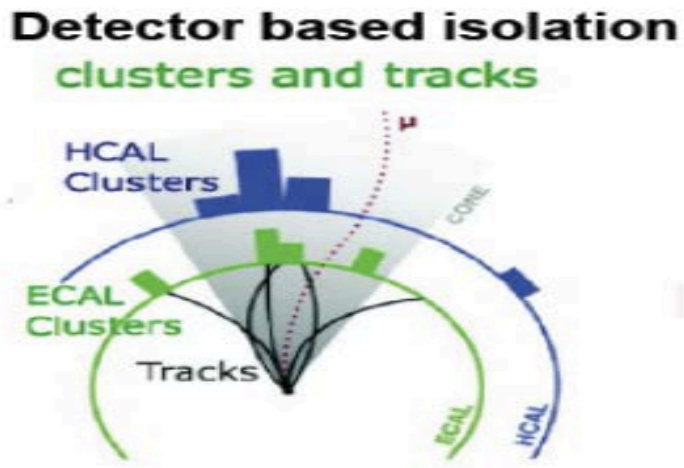
- **Muon isolation tool**
- DY/Z' decays into dimuons produce muons that are isolated.
- there is not a lot of other activity going on in a region around the muon's direction of flight.
- muons from heavy flavour decay will have jet activity around it.
- deposits in the calorimeters as well as more tracks (e.g. pions, kaons) reconstructed near the muon track.
- So one way to separate the background from QCD dijets and other sources of such "non-prompt" muons is to impose a cut on isolation variables.
- The recommendation of muon POG for 8 TeV analysis is to use the particle flow (PF) isolation tools.
- which relies on the iso-deposits of stable particles of any type (e.g. photons, neutral or charged hadrons, etc) reconstructed in an event.

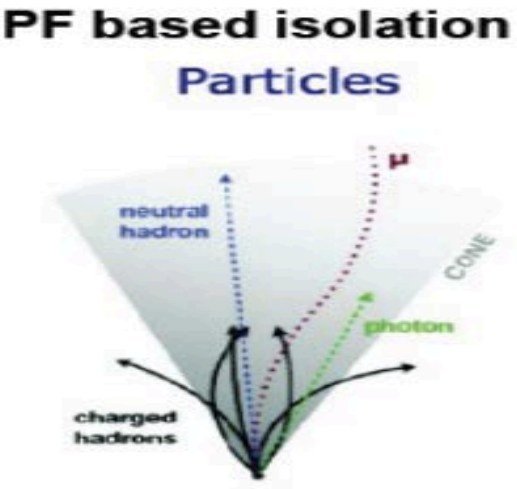
Types of energy deposits detector based and PF based isolation tools.

- Sum of p_T of charged and neutral hadrons in a cone around the muon's flight direction
- Sum of e-gamma energy deposits in a similar cone around the muon track
- Combinations of the above

The alternative approach is to use the detector based isolation tools:

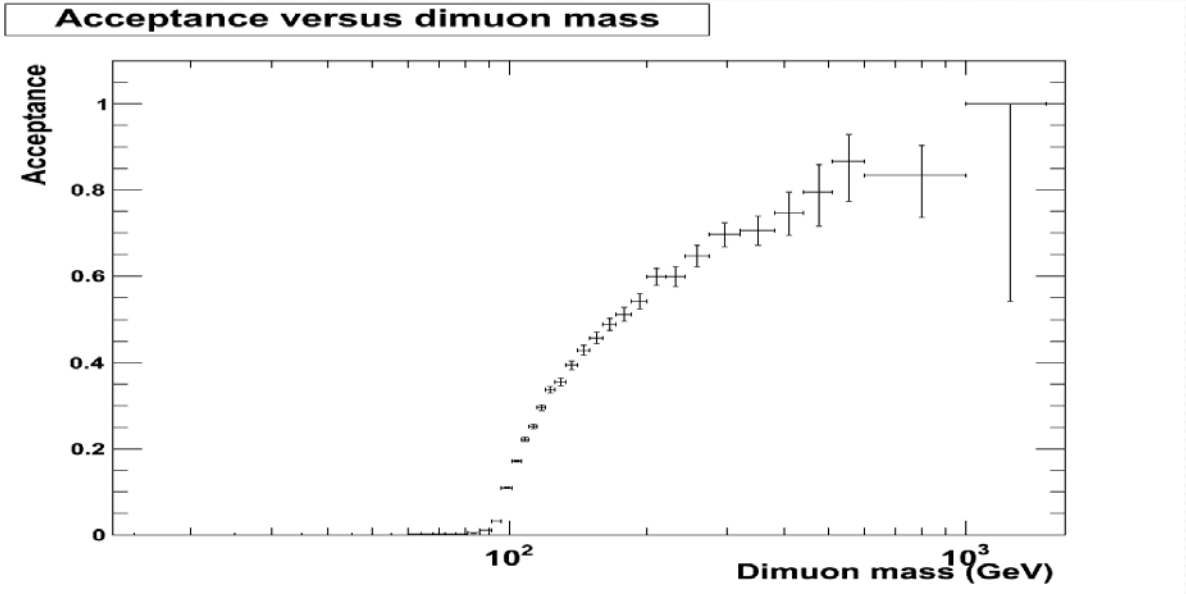
- Sum of energy deposits in the ECAL/HCAL in a cone around the muon's flight direction
- Sum of the p_T of other tracks in a similar cone around the muon track
- Consider some combination of the above
- The main effect that influences the isolation is pile-up , about 10^9 interactions per second.





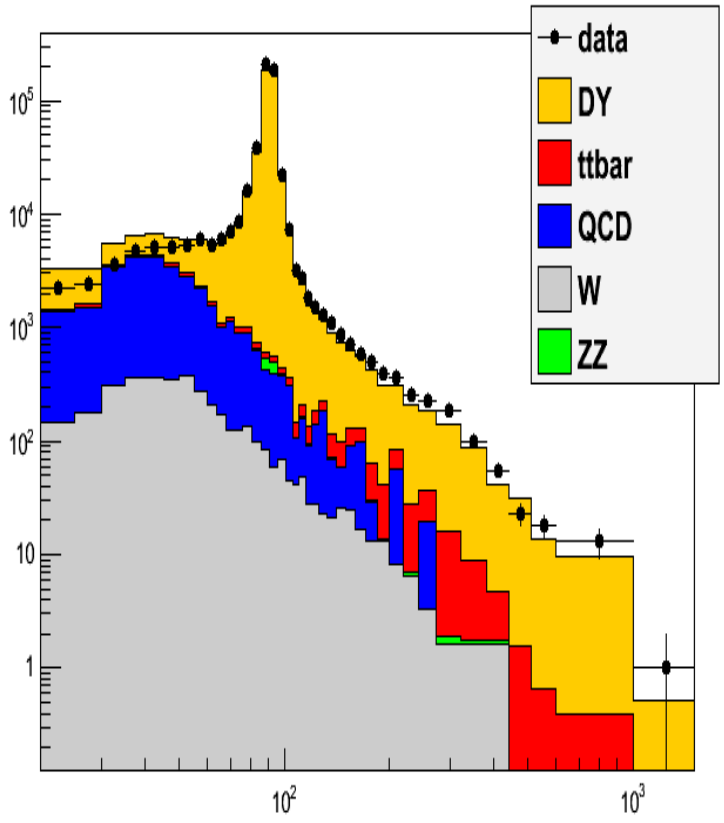
Effects of detector acceptance

- how often do both the muons even have a chance of being reconstructed? I.e., what is the value of the fraction
- acceptance = (Number of dimuons where both muons are in the nominal detector geometry) / (Number of total dimuons from the process)
- This is for all events of the DY (M > 20 GeV) sample and pt > 45 GeV and |eta|< 2.4 are applied.



background Histogram

of weighted MC datasets, data: histogram



weighted MC datasets, no data: histogram